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REPORTS

OF THE

DEPARTMENT OF COMMERCE

1915

REPORT OF THE SECRETARY OF COMMERCE

AND

REPORTS OF BUREAUS

WASHINGTON
GOVERNMENT PRINTING OFFICE
1916

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REPORT

OF THE

SECRETARY OF COMMERCE

7

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ANNUAL REPORT

OF THE

SECRETARY OF COMMERCE.

DEPARTMENT OF COMMERCE,
OFFICE OF THE SECRETARY,
Washington, October 30, 1915.

To the PRESIDENT:

I have the honor to submit herewith my third annual report, covering the operations and condition of the Department during the fiscal year which ended June 30, 1915, and tracing in a general way its history to the first of October, 1915.

Organization of Department.

The organization of the Department was changed during the fiscal year by the creation of the Federal Trade Commission, into which the Bureau of Corporations was merged on March 16, 1915. The eight bureaus which composed the Department at the close of the fiscal year were those of Foreign and Domestic Commerce, Standards, Census, Fisheries, Lighthouses, Coast and Geodetic Survey, Steamboat-Inspection Service, and Navigation. To these should be added the Office of the Secretary, consisting of five divisions, namely, Office of the Chief Clerk (including the Division of Supplies), Disbursing Office, Appointment Division, Division of Publications, and the Office of the Solicitor.

Injustice to Traveling Employees.

At the very outset, and to call special attention to them, let me outline certain salient matters arising from the year's work. I put in the forefront an injustice which requires remedy. Need exists for undoing a wrong now inflicted by law upon some of the officers of the Department. Your attention, and that of Congress, has been directed before to the fact that the legal limitation of $5 per diem for all subsistence expenses when traveling upon Government business operates to require public officers to pay at times a considerable portion of their expenses out of their own pockets, although incurred for Government purposes. This

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may at times be negligible though wrong in principle, but in the case of subordinates whose duty requires them to travel under conditions where subsistence can not be had within the legal limitations the law operates to work a serious reduction of salary, which is a grave injustice. To be specific, Steamboat-Inspection Service employees must at certain seasons travel constantly in Alaska, else their work would not be done and they would not earn their pay. It is not possible for them to travel within the $5 per diem limit allowed for subsistence. They receive from $1,200 to $2,000 per annum salary. The result, therefore, in the case of Jerome A. Desio, clerk to local inspectors, St. Michael, Alaska, was to deduct $58.91 from his salary of $118 for the month of July, 1914. In the case of Mr. Thomas E. Kell, local inspector of steamboats, St. Michael, Alaska, there was deducted from his salary for a like reason during July, August, September, and October, 1914, the sum of $70.32. In the case of Mr. Thomas P. Deering, local inspector of steamboats, St. Michael, Alaska, for July and August, 1914, there was deducted $70.35.

Fur wardens in the Alaska Service of this Department, whose duties require constant travel, receive salaries of $900 per annum. The requirement of law that these employees, out of their own salaries, help pay for subsistence expenses which they unavoidably incur solely on United States Government business works a wrong. From the account of Mr. William P. Hemenway, one of these fur wardens, for expenses during January, 1915, $12.50 was deducted. These were expenses properly payable by the Government but which could not be allowed because of the law. This same law also works a hardship upon the representatives of this Government traveling in South America, Europe, Asia, and Africa engaged in trade-promotion work. Their duties require that they have intercourse with merchants, importers, exporters, diplomatic and consular representatives of foreign countries. Considering charges in hotels of reasonable comfort in some foreign countries, their work can not be well done without adding out of their own pockets to the amount allowed by law for subsistence. In the case of one agent in Brazil, $41.91 was deducted to cover excess over the $5 per day limit charged in his voucher for November and December, 1914, and January, February, and March, 1915. In the case of another agent traveling in Brazil and Uruguay, $182.58 was deducted to cover excess over the $5 limit charged in his voucher for November and December, 1914, and January, February, and March, 1915. Another agent traveling in Chile, Bolivia, Peru, and

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Panama was required to pay $101.01 out of his own pocket to cover subsistence during April, May, and June, 1915.

I cite here only isolated cases. Most of the agents of the Department, knowing the legal limitation, do not even claim the full amount of subsistence expended by them. This matter was placed before the Appropriations Committee of both the House and the Senate, and the actual bills of fare of Alaskan restaurants were shown to the committees as evidence that the outlay for subsistence by employees in Alaska is unavoidable. The request, however, that the Secretary be given the right to regulate within fixed limits the allowance for subsistence in cases of this kind was refused and the injustice continues. The people of the United States do not desire to take petty advantage of their faithful servants, and I call attention to the facts that this matter may again be brought before Congress. Neither an extravagant nor unlimited allowance for subsistence is desired. Regulations existing before the enactment of the law were so framed that employees were compelled to make their subsistence charges reasonable, and, if proper discretion is given, such regulations will be made as will assure to the Government protection against extravagance, with full publicity, and to traveling employees reimbursement for every proper and necessary expense incurred when traveling in the discharge of their official duties.

Quarters for Federal Trade Commission.

An earnest request was made of the last Congress, both by the Federal Trade Commission and the Department of Commerce, that the former be allowed a sum for renting separate quarters. This was denied, and it was required that the Federal Trade Commission be accommodated within the Commerce Building. It was plainly stated by me to the proper committee that this would result in seriously hampering both the work of the Department and that of the Commission. The result then foreseen has followed. By squeezing an additional force into a space already restricted it has been physically possible to confine temporarily the force of the Federal Trade Commission within the limits of the Commerce Building. This required crowding employees in certain rooms, although an inspector of the Public Health Service had previously reported on inspection of the building that some rooms were overcrowded. The result has been to hamper the work of the Bureau of the Census at a time when the census of manufactures was actively proceeding, to forbid to several bureaus the normal

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expansion of space their growing work requires, and to provide the Federal Trade Commission with quarters insufficient for its work and so scattered as to be ineffective in operation. The Director of the Census, pointing out that the Federal Trade Commission occupies an important space in the Commerce Building, adds that the lack of suitable office accommodations has been a serious obstacle to the successful conduct of his work. He has been obliged to assign employees to rooms used for storage purposes, which made it impracticable to bring them under proper administrative control and to utilize them to the best advantage. The present arrangement is unsatisfactory, forcing three important services to work expensively and without proper effectiveness. On April 7, 1915, the Chief of the Bureau of Foreign and Domestic Commerce formally reported that "the Bureau has not sufficient floor space on which to properly conduct its work," and that several of the divisions of that service had to be shifted to relieve congestion.

Congress should provide funds promptly for the rental of quarters for the Federal Trade Commission in order that the space it now occupies may be made available for the employees of this Department. If this is not done, it will seriously overcrowd the building, will bring about insanitary conditions in the housing of the employees both in the Department and in the Federal Trade Commission, and will continue to restrict and make more costly the operations of both. Money supposed to be saved in such a way is wasted.

Attendance of Government Officials at Trade Conventions and Meetings.

In the District of Columbia appropriation act approved June 26, 1912 (37 Stat., 184), it is provided:

SEC. 8. No money appropriated by this or any other Act shall be expended for membership fees or dues of any officer or employee of the United States or of the District of Columbia in any society or association or for expenses of attendance of any person at any meeting or convention of members of any society or association, unless such fees, dues, or expenses are authorized to be paid by specific appropriations for such purposes or are provided for in express terms in some general appropriation.

This law had its origin in the fact that certain public officers had attended political conventions at the public cost. The remedy sought by the law is too sweeping and works evil. It operates to cripple the work of the Bureau of Foreign and Domestic Commerce and other important services of this Department. Under our duty to promote commerce we gather from all

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over the world important facts which it is necessary our merchants and manufacturers should have laid before them. The law puts us, however, in the absurd position that having gotten this knowledge for the use of the business world we are not permitted at public cost to go before any gathering or convention of any business or trade organization to tell them what we have learned in their behalf. It is also necessary that the scientific officers of the Bureau of Fisheries and other services should go before State and national societies interested in their work and inform them concerning it. This is a public function generally considered as of great value. Both of these duties, and others like them, can now be carried out only when other circumstances happen to permit the more or less accidental presence of our officers at the place where the gathering is held before which they desire to place information. To quote from my last report:

> It surely was not the intention that the law should prohibit the commercial representatives of the country from making known directly to business organizations the information which they have traveled far and labored hard to get, yet this is the effect of the restriction embodied in the law.

It is absurd that an officer of the United States, having gathered at public cost valuable information for the benefit of manufacturers all over the land, should not be permitted to lay those facts before a convention of such manufacturers except at his own personal expense or when some other reason for his presence can be contrived.

Costly Naval Crews.

The steamers *Albatross* and *Fish Hawk*, of the Fisheries Service, are operated by naval crews commanded by warrant officers of the Navy under the direction of a civil officer of the Bureau of Fisheries. The crew of the *Albatross* numbers 81 officers and men and that of the *Fish Hawk* 44 officers and men. A more expensive arrangement than this could hardly be devised. The vessels are admirably handled, but if they had civilian crews, like the other ships of the Department, there would be an immediate and considerable saving to the Government, and the Navy crews with their officers would be restored to the naval service, where they are needed. These two vessels, operated on a civilian basis like our others, would require, in the case of the *Albatross*, 35 officers and men, instead of 81, and in the case of the *Fish Hawk* 26 officers and men, instead of 44 as at present. The naval appropriation would be unchanged, for these men now on the pay roll of the Navy would

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be transferred to their normal work in that department. The appropriation of the Department of Commerce would have to be increased to cover the expense of the civilian crews. Taking into consideration the subsistence allowance in the Navy, the reduction of the cost of operating the vessels would be over $27,000 per annum, while the Navy Department would have restored to its service officers and enlisted men whom it requires. The Secretary of the Navy approves the change and a request to that effect will be made of Congress.

Vessels Idle for Lack of Funds.

Quite as important, or more so, is the fact that because of lack of funds the steamer *Albatross*, with her naval crew under full pay, lay for *nine and a half months idle* at Alameda, Cal. There was no money to pay for coal and other needed operating expenses, while important work, long promised and urgently required and which large sections of our public on the Pacific coast await with impatience, was left undone. For the same reason, the schooner *Grampus* was also idle for seven months with important work waiting to be done. Both the *Albatross* and the *Grampus* face the same prospect during the present fiscal year. Both were specially built for the work they are not now permitted fully to do.

It is imperatively necessary that there be a substantial increase in the appropriation for the maintenance of vessels of the Fisheries Service, unless it is to be the deliberate policy of the Government that these vessels shall remain idle when important work which immediately affects our food supply waits to be done. The sum of $15,000 (fuel, $12,000; maintenance, $3,000) would have kept the *Albatross* in operation on useful work during a time when the pay of the naval crew and other permanent charges against the vessel exceeded $30,000. Congress was requested to provide $80,000 for the maintenance of the fisheries vessels. It did provide $60,000. An emergency arose requiring the presence of the *Albatross* at the Pribilof Islands during the early weeks of the fiscal year, and the appropriation was so limited that she had to lie idle for almost the entire balance of the year while her crew were under full pay.

New and Old Ships.

The wise provision by Congress of funds for the marine services of the Department has borne marked fruit. The lighthouse tender *Cedar*, which will be the largest and most efficient vessel in the

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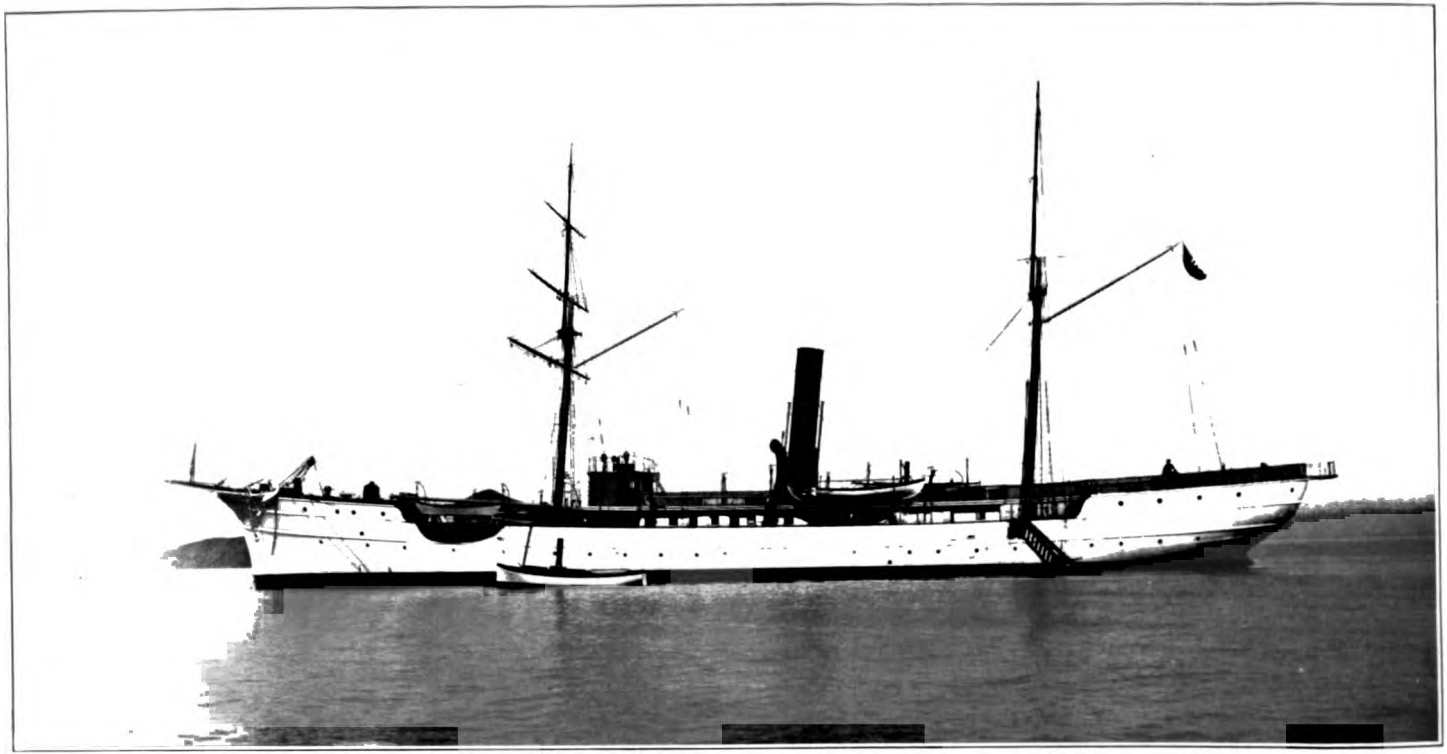

BUREAU OF FISHERIES STEAMER "ALBATROSS."

This vessel, the most perfectly equipped for its use, lay idle 9½ months with crew under full pay for lack of appropriation for coal and supplies while urgent work affecting large Pacific coast interests was waiting to be done.

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Lighthouse Service, is now under construction at Long Beach, Cal. She replaces the lost *Armeria*, wrecked on an unknown pinnacle rock. A contract has been made for the construction of the new Coast Survey steamer *Surveyor* at Manitowoc, Wis. She will be the most effective vessel ever furnished to that service. She will replace the *McArthur*, one of the two antiques—the *Gedney* being the other—described in my last report which have descended from almost prehistoric times (for steamships) to be an incubus to the service and a menace to their officers and crews. Both the above new vessels were designed by the naval architects of the Department and will be inspected during their construction by its officers. The public is indebted to the Commissioner of Lighthouses, Mr. G. R. Putnam, and to the superintendent of marine construction of the Lighthouse Service, Mr. E. C. Gillette, for valuable services in connection with the designing of these important ships and for their cordial cooperation with the Coast Survey in preparing the plans for the *Surveyor*.

The *Gedney* and the *McArthur* are no longer fit for use. They will be withdrawn at the close of the present season, and will be condemned and sold. It is urgently necessary to replace the *Gedney* with a new vessel. The steamer *Patterson* will hardly last till a new ship can replace her. She is 33 years old, structurally weak, underpowered, and is worn out. It will not be safe to use her much longer. It is proposed that the new vessels shall be so made as to be capable of assistance to the Navy should they be needed. Our estimates for the coming fiscal year include the cost of these two new ships.

The steamship *Roosevelt*, of Arctic fame, has been purchased for the Fisheries Service. Her use in Alaskan waters will put an end to the habit, honored by custom but by nothing else, of calling upon parties to be inspected for the means of making the inspection. She will for the first time permit communication with the Pribilof Islands in the winter season and will provide for the Government service in Alaska a vessel specially suited for coping with ice conditions. She is now at the Norfolk Navy Yard undergoing necessary alterations to fit her for our service.

These three vessels—the *Cedar*, the *Surveyor*, and the *Roosevelt*—each the best of its kind, will serve Alaska and the Pacific Northwest and will provide for those waters an effectiveness in their respective services heretofore unknown.

The motor vessel *Dixie* has been purchased for the Atlantic service of the Bureau of Navigation and has been for some months

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in active work. The fine seagoing steamer *Isis* has been purchased for the Atlantic offshore service of the Coast and Geodetic Survey and is in service. She replaces the feeble and worn-out *Endeavor*, which was described in my last report. The small lighthouse tender *Fern*, for use in Alaska, has been accepted. The small lighthouse tender *Laurel* has been completed and put in service in the shallow waters of our middle Atlantic coast. The contract has been awarded for the construction of the lighthouse tender *Rose*, for use on the coasts of Oregon and Washington. Contract has been awarded for building the tender *Palmetto* at Jacksonville, Fla. A study is being made for a new lightship for Nantucket Shoals, for which funds are available. Plans are preparing for the *Halcyon*, a new vessel for the Bureau of Fisheries. This by no means completes the list of added vessels, for details of which reference is made to the reports of the respective services.

The Department had the following vessels in its marine services on October 1, 1915:

	In operation.	Being built.	Total.
Coast and Geodetic Survey	12	1	13
Bureau of Navigation	2	.....	2
Bureau of Lighthouses:			
Tenders	47	3	50
Light vessels	65	2	67
Bureau of Fisheries	10	1	11
Total	136	7	143

This is exclusive of 4 vessels loaned to the Coast and Geodetic Survey by the Philippine Government and of 44 motor boats of all sizes operated by the Bureau of Fisheries.

The "Eastland" Disaster.

The deplorable accident to the steamer *Eastland*, though it occurred on July 24 after the close of the fiscal year, brought the work of the Steamboat-Inspection Service prominently before the public. The inquiry required by law (sec. 4450, Rev. Stat.), which promptly followed at the hands of the local board of inspectors of Milwaukee, was assisted by an unofficial board of inquiry comprising Hon. Barrett O'Hara, lieutenant governor of Illinois; Mr. H. A Wheeler, Mr. Marvin B. Pool, both of Chicago; Mr. Philip B. Fouke, of St. Louis, chairman of the committee on the Steamboat-Inspection Service of the Chamber of Commerce of the United States; Naval Constructor James L. Ackerson, U. S. N.; and Mr.

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E. C. Gillette, superintendent of marine construction, United States Lighthouse Service. The inquiry took place under the direction of Mr. A. L. Thurman, Solicitor of the Department of Commerce, and myself. The board of inquiry at its adjournment, taken pending the action of the Federal grand jury, unanimously concurred in a statement which is printed herein under the caption of the Steamboat-Inspection Service. Notice is given it here to emphasize the importance of the recommendation that this Service be placed upon a scientific as well as upon a practical basis through the establishment of the board of naval architects for which the statement calls. This is a remedial measure of the highest value which would provide a technical marine inspection, heretofore impossible, for which neither force nor funds have been provided but which would safeguard at the source, so to speak, all parties in interest in our merchant-marine service as is not now practicable.

I here emphasize the fact that the Steamboat-Inspection Service is at many points both undermanned and overworked. On December 3, 1914, in my address before the New York Maritime Exchange, this was clearly stated. It is due to the public and to the Service that these words then used be reprinted here:

Should some day an accident occur because there was not time for the searching study at which we aim or because an exhausted inspector passed something over, we will deal firmly with it, but the responsibility will not in the last analysis rest with us but with those who provide and with those who can move the providers to provide.

Deficiencies of Motor-Boat Laws.

In two previous reports and again herein the dangers arising under the present motor-boat laws are plainly stated. For the sake of emphasis, and that this Department may not be justly charged with failing to make the facts plainly known, the following words, twice heretofore published, are repeated:

The Department, however, has no direct power over a motor vessel either as regards passengers or machinery. It can inspect the hull, tanks, and piping, but only when the vessel is of 15 tons measurement or more, and when it carries passengers or freight for hire. If, for example, the motor vessel is a private vessel of over 15 tons measurement, the Department can not inspect her in any way. Even if she is a towing motor vessel of this size, there exists no lawful power to inspect her.

The Department can not limit the number of passengers carried for hire on a motor vessel, however big, except by fixing the life-saving equipment. Over motor vessels smaller than 15 tons the powers of the Department are limited to seeing them provided with the necessary life-saving equipment, lights, life preservers, and means of extinguishing gasoline fires. Here the present powers of the Government stop.

I wish to make this perfectly plain. If a Government inspector stands upon a dock watching a motor boat sail away with three times as many passengers as she ought to have and her machinery defective and her hull leaking, he would have no

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power in the premises, were she a motor boat under 15 tons measurement, except to see that there was a life preserver in good order provided for every passenger on board, that she had the proper lights and the proper means of extinguishing gasoline fires, with a whistle and a bell of standard dimensions. He could, indeed, require such a vessel to have a licensed operator, but for that license no examination is required. * * * At present a person may obtain a license as operator of motor vessels without being a citizen of the United States or without being 21 years of age, and while being unable to read or write. Under the law, licenses to operators of motor boats are issued without any examination whatever. The inspectors of the inspection service are without authority to ask whether the person applying for such motor-boat license is color blind or whether he understands or can read the pilot rules. Yet such persons, having a license so obtained, may, and in fact do, take charge of motor vessels carrying passengers for hire. Operators of motor boats should be required to show that they are not color blind and have good vision, that they can read the pilot rules and laws, and that they have a reasonable knowledge of them. The existing conditions are a menace to the lives of innocent and unsuspecting passengers and should not be permitted to continue.

Here and now for the THIRD TIME the Department makes these facts clear and asks the authority, which it now lacks, to protect the lives of innocent passengers. If that authority is not furnished, the responsibility for the loss of life which is certain to happen will not rest upon the Department. Fortunately, as is explained under the heading of the Navigation Service herein, men with vision connected with motor-boat interests are appreciating the dangers of the existing conditions and are united with the Department in favoring the legislation which is described and which will be submitted to Congress at its next session.

Expansion in Foreign Trade.

As this is written the balance of trade in favor of the United States on merchandise transactions for the nine months elapsed of the current calendar year is in excess of twelve hundred million dollars, a fact not only unprecedented but of profound import alike to America and Europe. We are now the greatest creditor nation, and the balance is likely to grow in our favor as the crops are shipped. The world of international finance is stirred to find new methods of providing the necessary credits which shall cover the vast sums due to us. It is, of course, true that this condition brings with it problems and even dangers, yet it is equally true that it brings opportunities if we have the vision and the courage to seize them.

Alone of all the great industrial nations we are at peace. We alone have in full measure and undisturbed by war's alarms the plants, the labor, and the means to supply the wants of mankind. The nations turn to us. The report of the Chief of the Bureau of

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Foreign and Domestic Commerce shows with clearness the extraordinary expansion of his service and the opportunity that awaits it. I deem it of national importance that this Bureau, which shows such practical and tangible results of its activity, shall be supported with the men and the money necessary to carry on its great work in behalf of American commerce effectively and widely. I purpose to ask from Congress an enlarged appropriation for this important work, which is so directly profitable and in which the merchant and the laborer, the manufacturer and the transporter, have a deep and common interest. I shall therefore ask that the force of commercial attachés be increased from 10 to 20, that increased sums be provided for the traveling commercial agents, and that the clerical staff be sufficiently enlarged to cope with the volume of work our growing foreign business thrusts upon it and under which it is to-day seriously overburdened. When a service can point to orders in excess of a million dollars each, given to our industries as the direct results of its activities, it is entitled to the best of support.

Government-Owned Building for the Department.

The lease at $17,500 per annum for the addition to the Commerce Building, which was constructed that we might accommodate the Bureau of the Census under the same roof with the other bureaus of the Department occupying rented quarters, was made on July 1, 1914, and terminates on August 31, 1918, the date on which the lease for the original Commerce Building expires. The total saving resulting from moving the Bureau of the Census into the Commerce Building has been during the fiscal year just ended $24,580, a sum slightly larger than was expected.

The act of May 30, 1908 (35 Stat., 545), authorized and directed the Secretary of the Treasury to acquire land for the use and accommodation of the Departments of State, Justice, and Commerce and Labor, and the Secretary of the Treasury has done so. The act of June 25, 1910 (36 Stat., 698), authorized and directed the Secretary of the Treasury to prepare designs and estimates for a separate fireproof building for each of the Departments of State, Justice, and Commerce and Labor, to be erected upon the land acquired under the act of May 30, 1908 (supra), at a cost not to exceed $8,000,000. On March 3, 1913, the plans for the proposed building for the Department of *Commerce and Labor* were approved by my predecessor. These plans did not provide for the accom-

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modation of the Bureau of Fisheries or the Coast and Geodetic Survey in the proposed new building. In view of the fact, however, that four bureaus which were to be housed in the proposed new building have been transferred to the Department of Labor and another bureau to the Federal Trade Commission, I am confident that the plans can be so revised that the building can accommodate the Coast and Geodetic Survey and the administrative offices of the Bureau of Fisheries.

As the lease for the Commerce Building, which the Department now occupies, will expire within three years, it will be necessary to proceed promptly in the matter of providing the new Government building for this Department if it is to be ready for occupancy by that time. The construction of such a building is urged not only in the interest of efficiency and good administration but also in the interest of economy. At the present time the Department is paying $65,500 for the rental of the enlarged building, which, although not unreasonable when compared with other rental rates in the District of Columbia, represents an income of 3 per cent on $2,183,333.

In my last annual report I pointed out the desirability of having the bureaus of this Department, except the Bureau of Standards, housed in one Government building. The experience gained by having five of our bureaus housed in the same building with the divisions of my own immediate office accentuates the loss of money and effectiveness in having the Bureau of Fisheries and the Coast and Geodetic Survey separated from the rest of the Department. It is never good business practice to scatter a department through several buildings located in different parts of the city. This is a cause of hourly waste, a producer of delays, and a creator of inefficiency. If poverty compels such a wasteful course to be pursued, it should at least be accepted only as a temporary makeshift which common sense would end as soon as money could be found. Under the headings of the respective services I speak in detail of the buildings which now confine rather than contain both. I renew my protest against the policy of paying rent to private parties for buildings for the public service, especially when this requires the work of a department to be split into parts at enhanced cost for operation.

Modern Aquarium for the Bureau of Fisheries.

The fishing industry throughout the land, whether on river, lake, or ocean, the interest of science studying how to maintain and enlarge the supplies of food which our waters provide, the

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interest of those who fish for sport the country over, would all be enhanced by providing a modern aquarium for the Bureau of Fisheries, suited alike for the scientific work of the Bureau and for those scientists who collaborate with it for the development of the fishing industry, and for the education of the public. This aquarium should be housed in a separate building located as nearly as practicable to the proposed new building for the Department. The public interest in such an aquarium appears in the throngs that have visited the exhibit of the Bureau of Fisheries at the Panama-Pacific International Exposition at San Francisco and in the number of visitors at the small temporary aquariums of the Fisheries Service in Washington and in Woods Hole, Mass.

The aquarium, however, would not be primarily to furnish amusement or to provide a place of pleasant public resort. These are incidental uses which because of their educational value are important. The aquarium would be useful chiefly as a working tool to provide new sources of food supply and to improve those already existing. It is a singular thing that so practical a people as we talk so much about the cost of living and do so little about it. There are huge quantities and a large variety of unused fish foods of excellent quality of which we hardly know. An acre of water on a farm is equal to an acre of good land in food-producing value. We wisely establish agricultural experiment stations, but why stop there? It is quite as possible to improve the breed of fishes in size and in food value as it is to develop plants in like characteristics. What is true of plant life, of cattle and horses as regards improving their quality and number, is just as true of fish, and the infinite variety of fish far surpasses that of all other animals put together.

Three things are possible by the use of such an aquarium which without it are either impracticable or at best will be long delayed. These are (1) new sources of food supplies; (2) the improvement of the food supplies now existing; and (3) the enlargement of the present supply.

The aquarium, therefore, would serve as an experiment laboratory or station used for the public good, similar to the use made of the agricultural experiment stations. It would be for the benefit of the farmer, because it would make possible the extension of the service now directed to him, providing fish food supplies in small ponds on the farms. It would be an aid to the dweller in the city, because it would enlarge the fish food supply now within his reach and provide new ones. Thus it would be of universal

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value, not local, certainly not a mere matter of providing the seeker of pleasure with means of pleasure, but a practical service to many. A bill will be introduced, with the approval of the Department of Commerce, asking the authorization of such an aquarium-laboratory at the next session of Congress.

At a time when the high cost of living is a matter of keen public interest, the Bureau of Fisheries has caused to be placed in the public markets wholly new supplies of food, cheap and valuable, and can cause others to be so placed. It should receive the fullest practicable encouragement respecting an aquarium, not as a means of display but as a working tool through whose use may come practical benefits.

Miscellaneous.

The Department has a 1,500-pound capacity gasoline truck in operation carrying mail between the post office, the Commerce Building, the Bureau of Fisheries, and the Coast and Geodetic Survey, and making miscellaneous trips. The service has fully justified the appropriations which permit the purchase of motor-propelled vehicles to replace horse-drawn vehicles. The truck has run 10,954 miles during the year, averaging 38.3 miles for each operating day, and making approximately 12.5 miles on each gallon of gasoline used The total cost of maintaining the truck a year amounted to $486.42—less than 4½ cents per mile. This is an excellent showing, especially when it is considered that three horses, three wagons, and an electric truck were formerly used to do the work which is now being done by this truck.

The Department also uses a 2,000-pound capacity gasoline truck for hauling supplies between the Commerce Building, the Bureau of Fisheries, the Coast and Geodetic Survey, and the freight depots. Although this truck was not bought until November 10, 1914, it has covered 4,444 miles, averaging 22.64 miles each day, running approximately 10 miles per gallon of gasoline.

The purchase of these automobile trucks enabled the Department to reduce its stable equipment by four horses and four wagons and to dispose of the worn-out electric truck formerly used by the Bureau of the Census. The Department therefore changed its stable quarters, so saving $800 in annual rent. The cost of maintaining the stable during the year (exclusive of rent) was reduced $1,442.21. In addition two employees were withdrawn from the stable force and assigned to other duties.

The work of the consolidated library in the Commerce Building has progressed steadily during the year. There are about

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100,000 volumes in the library; 2,570 volumes were added during the year. One thousand and thirty-one weekly and monthly periodicals are currently received, 997 of which are received in exchange for the Department's publications. During the year 9,723 duplicates were disposed of and 821 volumes were sent to the Government Printing Office for binding and rebinding. The classification used in the Library of Congress has been adopted.

The Department purchased during the year 161 typewriters, 85 for use in the District of Columbia and 76 for the outside service. The total cost was $10,770.96. The allowance for old machines given in exchange was $2,807.50, making an outlay for new machines of $7,963.46, an average price of $49.46 paid for each machine.

An interesting feature of the year was the presentation of a gold watch and chain to Capt. Paul H. Kreibohm, and gold, silver, and bronze medals to the officers and crew of the American steamer *Kroonland* for rescuing 89 people from the burning steamer *Volturno* in the North Atlantic Ocean during October, 1913.

With the $55,625 allotted to it by the Government Exhibit Board, this Department has been able to make exhibits at the Panama-Pacific International Exposition at San Francisco, Cal., illustrating the work of the following Bureaus: Census, Foreign and Domestic Commerce, Standards, Fisheries, Lighthouses, Coast and Geodetic Survey, and Navigation. The exhibits of the Department were awarded 5 grand prizes, 4 gold medals, 3 silver medals, 12 medals of honor, and were honorably mentioned once. The representatives of the Department were awarded silver medals as collaborators.

Appropriations and Expenditures.

The itemized statement of the disbursements from the contingent fund of the Department of Commerce and the appropriation for "General expenses, Bureau of Standards," for the fiscal year ended June 30, 1915, required to be submitted to Congress by section 193 of the Revised Statutes of the United States, the itemized statement of expenditures under all appropriations for propagation of food fishes during the fiscal year ended June 30, 1915, required by the act of Congress approved March 3, 1887 (24 Stat., 523), and a statement showing travel on official business by officers and employees (other than the special agents, inspectors, and employees in the discharge of their regular duties, who are required to travel constantly) from Washington to points outside of the Dis-

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trict of Columbia during the fiscal year ended June 30, 1915, as required by the act of Congress approved May 22, 1908 (35 Stat., 244), will be transmitted to Congress in the usual form.

The following table shows the total amounts of all appropriations for the various bureaus and services of the Department of Commerce for the fiscal year ended June 30, 1915:

Bureau.	Legislative act.	Sundry civil act.	Deficiency act.	Special acts.	Total.
Office of the Secretary	[a] $276,244.17		$2,025.82		$278,269.99
Bureau of Corporations	[b] 251,300.00				251,300.00
Bureau of Lighthouses	64,050.00	$5,223,600.00	252,963.72	$5,888.40	5,546,502.12
Bureau of the Census	1,538,346.67		246.87		1,538,593.54
Bureau of Foreign and Domestic Commerce	396,989.59				396,989.59
Steamboat-Inspection Service	532,998.33		22.66		533,020.99
Bureau of Navigation	172,030.00		15,000.00	6,088.79	193,118.79
Bureau of Standards	623,393.33	65,000.00	28.55		688,421.88
Bureau of Fisheries		1,088,471.66	50,050.89		1,138,522.55
Coast and Geodetic Survey		1,039,278.34	5.42		1,039,283.76
Total	3,855,352.09	7,416,350.00	320,343.93	11,977.19	11,604,023.21
Allotment for printing and binding		[c] 400,000.00			[c] 400,000.00
Grand total		7,816,350.00			12,004,023.21

[a] Of this amount, $2,206.29 was transferred to the Federal Trade Commission.
[b] Of this amount, $87,512.49 was transferred to the Federal Trade Commission.
[c] Of this amount, $12,386.76 was transferred to the Federal Trade Commission.

The disbursements by the Disbursing Clerk of the Department of Commerce during the fiscal year ended June 30, 1915, arranged according to items of appropriation, are as follows:

OFFICE OF THE SECRETARY.

Salaries, Office of the Secretary of Commerce, 1914	$6,145.80
Salaries, Office of the Secretary of Commerce, 1915	144,398.13
Contingent expenses, Department of Commerce, 1913	63.89
Contingent expenses, Department of Commerce, 1914	23,542.26
Contingent expenses, Department of Commerce, 1915	70,735.55
Rent, Department of Commerce, 1914	4,150.00
Rent, Department of Commerce, 1915	60,991.63
Total	310,027.26

BUREAU OF CORPORATIONS.

Salaries, Bureau of Corporations, 1914	3,150.12
Salaries, Bureau of Corporations, 1915	54,562.55
Salaries and expenses, special attorneys, Bureau of Corporations, 1914	10,067.86
Salaries and expenses, special attorneys, Bureau of Corporations, 1915	109,291.94
Total	177,072.47

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BUREAU OF FOREIGN AND DOMESTIC COMMERCE.

Salaries, Bureau of Foreign and Domestic Commerce, 1914	$4,233.07
Salaries, Bureau of Foreign and Domestic Commerce, 1915	113,516.64
Promoting commerce, Department of Commerce, 1913	.44
Promoting commerce, Department of Commerce, 1914	4,356.96
Promoting commerce, Department of Commerce, 1915	51,724.13
Collating tariffs of foreign countries, 1914	553.79
Collating tariffs of foreign countries, 1915	404.16
Investigating cost of production, Department of Commerce, 1914	3,778.28
Investigating cost of production, Department of Commerce, 1915	43,785.86
Promoting commerce, South and Central America, 1915	13,303.35
Commercial attachés, Department of Commerce, 1915	18,652.73
Total	254,309.41

BUREAU OF STANDARDS.

Salaries, Bureau of Standards, 1914	11,595.03
Salaries, Bureau of Standards, 1915	266,464.62
Laboratory, Bureau of Standards	77.64
Equipment, Bureau of Standards, 1913	570.27
Equipment, Bureau of Standards, 1914	3,192.24
Equipment, Bureau of Standards, 1915	38,183.90
General expenses, Bureau of Standards, 1913	40.39
General expenses, Bureau of Standards, 1914	4,080.89
General expenses, Bureau of Standards, 1915	19,729.65
Testing machines, Bureau of Standards, 1913	2.10
Testing machines, Bureau of Standards, 1914	5,556.71
Testing machines, Bureau of Standards, 1915	28,319.35
Testing structural materials, Bureau of Standards, 1914	3,521.58
Testing structural materials, Bureau of Standards, 1915	84,586.48
Refrigeration constants, Bureau of Standards, 1913	317.72
Refrigeration constants, Bureau of Standards, 1914	3,166.98
Refrigeration constants, Bureau of Standards, 1915	13,996.45
Investigating effects of electric currents, Bureau of Standards, 1913	1.40
Chemical laboratory, Bureau of Standards	2,375.00
Current meter testing tank, Bureau of Standards, 1913	32.93
Electrical laboratory equipment, Bureau of Standards, 1913–14	18.28
Workshop and storehouse, Bureau of Standards	24,957.45
Improvement and care of grounds, Bureau of Standards, 1914	109.26
Improvement and care of grounds, Bureau of Standards, 1915	5,641.94
High-potential investigations, Bureau of Standards, 1914	1,389.67
High-potential investigations, Bureau of Standards, 1915	13,218.51
Testing railroad scales, Bureau of Standards, 1914	3,742.23
Testing railroad scales, Bureau of Standards, 1915	17,444.47
Investigation of fire-resisting properties, Bureau of Standards, 1914	13,858.04
Investigation of fire-resisting properties, Bureau of Standards, 1915	15,683.85
Testing miscellaneous materials, Bureau of Standards, 1915	18,764.61
Investigation of railway materials, Bureau of Standards, 1915	10.425.00
Investigation of public-utility standards, Bureau of Standards, 1915	16,698.66
Total	627,763.30

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STEAMBOAT-INSPECTION SERVICE.

Salaries, Office of Supervising Inspector General, Steamboat-Inspection Service, 1914	$610. 03
Salaries, Office of Supervising Inspector General, Steamboat-Inspection Service, 1915	14, 783. 94
Salaries, Steamboat-Inspection Service, 1914	28, 477. 02
Salaries, Steamboat-Inspection Service, 1915	322, 304. 92
Clerk hire, Steamboat-Inspection Service, 1914	6, 903. 42
Clerk hire, Steamboat-Inspection Service, 1915	76, 907. 32
Contingent expenses, Steamboat-Inspection Service, 1913	25. 08
Contingent expenses, Steamboat-Inspection Service, 1914	15, 538. 92
Contingent expenses, Steamboat-Inspection Service, 1915	64, 175. 90
Steamboat-Inspection Service, Los Angeles, Cal., 1914	616. 77
Total	530, 343. 32

BUREAU OF NAVIGATION.

Salaries, Bureau of Navigation, 1914	1, 386. 71
Salaries, Bureau of Navigation, 1915	30, 351. 72
Salaries, Shipping Service, 1914	2, 399. 52
Salaries, Shipping Service, 1915	27, 578. 96
Clerk hire, Shipping Service, 1914	2, 918. 02
Clerk hire, Shipping Service, 1915	32, 241. 97
Contingent expenses, Shipping Service, 1914	3, 728. 56
Contingent expenses, Shipping Service, 1915	1, 900. 13
Enforcement of wireless-communication laws, 1913	300. 38
Enforcement of wireless-communication laws, 1914	2, 321. 62
Enforcement of wireless-communication laws, 1915	40, 544. 94
Enforcement of navigation laws, 1914	1, 127. 42
Enforcement of navigation laws, 1915	19, 080. 30
Admeasurement of vessels, 1914	304. 76
Admeasurement of vessels, 1915	2, 289. 14
Preventing overcrowding of passenger vessels, 1915	8, 069. 48
Instruments for counting passengers, 1915	216. 92
Watch and medals for officers and crew of American steamer *Kroonland*.	494. 85
Total	177, 255. 40

BUREAU OF FISHERIES.

Salaries, Bureau of Fisheries, 1914	26, 648. 96
Salaries, Bureau of Fisheries, 1915	337, 684. 42
Miscellaneous expenses, Bureau of Fisheries, 1913	68. 16
Miscellaneous expenses, Bureau of Fisheries, 1914	37, 746. 02
Miscellaneous expenses, Bureau of Fisheries, 1915	395, 848. 68
Protecting seal and salmon fisheries of Alaska, 1913	50. 15
Protecting seal and salmon fisheries of Alaska, 1914	2, 870. 92
Protecting seal and salmon fisheries of Alaska, 1914–15	45, 543. 11
Protecting seal and salmon fisheries of Alaska, 1915	41, 975. 71
Payment to Great Britain and Japan	20, 000. 00
Launch for fish hatcheries, Mississippi Valley	35. 43
Vessels and boats, Alaska fishery service, 1915	43, 263. 62
Marine biological station, North Carolina, 1915	4, 864. 64
Vessels, fish hatchery, Boothbay Harbor, Me., 1915–16	66. 16
Philippine fisheries report	10. 06

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Fish hatcheries:	
Cape Vincent, N. Y.	$5.63
Clackamas, Oreg.	7.85
Edenton, N. C., 1915.	7.47
Kentucky.	1,495.93
Puget Sound, Wash.	3,697.37
South Carolina.	1,478.66
Upper Mississippi Valley.	7,897.25
Washington.	911.10
Woods Hole, Mass.	42.62
Wyoming.	8,975.91
Total.	981,195.83

BUREAU OF THE CENSUS.

Salaries, Bureau of the Census, 1914.	29,222.67
Salaries, Bureau of the Census, 1915.	646,182.01
Collecting statistics, Bureau of the Census, 1913.	.20
Collecting statistics, Bureau of the Census, 1914.	21,497.20
Collecting statistics, Bureau of the Census, 1915.	772,437.47
Tabulating machines, Bureau of the Census, 1914.	912.49
Tabulating machines, Bureau of the Census, 1915.	11,468.23
Rent, Bureau of the Census, 1914.	1,750.00
Total.	1,483,470.27

BUREAU OF LIGHTHOUSES.

Salaries, Bureau of Lighthouses, 1914.	2,770.48
Salaries, Bureau of Lighthouses, 1915.	60,428.79
General expenses, Lighthouse Service, 1913.	998.52
General expenses, Lighthouse Service, 1914.	23,244.94
General expenses, Lighthouse Service, 1915.	35,598.77
Salaries, Lighthouse Service, 1914.	270.00
Salaries, Lighthouse Service, 1915.	7,195.08
Salaries, lighthouse vessels, 1915.	300.00
Aids to navigation, Alaska.	29.07
Cape Cod Canal lights, Mass.	39.57
Cape Fear River lights, N. C.	11.42
Fort McHenry Channel range lights, Md.	19,589.04
Brandywine Shoal Light Station, Del.	27,940.00
Cape St. Elias Light Station, Alaska.	4,126.37
Thimble Shoal Light Station, Va.	38,671.92
Tender for first lighthouse district.	37,851.88
Tender for fifteenth lighthouse district.	17,604.44
Tender for engineer, sixth lighthouse district.	435.67
Lighthouse tender, general service.	652.80
Point Abino Light Vessel, Lake Erie.	9,777.84
Light vessels for general service.	25,886.63
Depot for sixth lighthouse district.	60,000.00
Southwest Pass Light Vessel, Mississippi River, La.	1,485.59
Aids to navigation, Ashtabula Harbor, Ohio.	7.00
Total.	374,915.82
Grand total.	4,916,353.08

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The following statement shows the expenditures during the fiscal year ended June 30, 1915, on account of all appropriations under the control of the Department, giving the total amounts disbursed by the various disbursing officers of the Department and miscellaneous receipts for the same period:

By the Disbursing Clerk, Department of Commerce, on account of salaries and expenses of the Office of the Secretary of Commerce, the Bureaus of Corporations, Foreign and Domestic Commerce, Navigation, Standards, Fisheries, and Lighthouses, the Office of the Supervising Inspector General, Steamboat-Inspection Service, salaries and expenses of Steamboat-Inspection Service at large, and public works of the Lighthouse and Fisheries Services (shown in detail in the foregoing table of disbursements)		$4,916,353.08
By the authorized disbursing officers of the Lighthouse Service		5,101,416.67
By the special disbursing agent, Coast and Geodetic Survey, on account of salaries and expenses of the Coast and Geodetic Survey		1,037,605.33
By the commercial agents of the Department investigating trade conditions abroad, as special disbursing agents		104,512.82
By special disbursing agents, Bureau of Fisheries		24,443.51
By warrants drawn on the Treasurer of the United States to satisfy accounts settled by the Auditor for the State and Other Departments, classified as follows:		
Office of the Secretary	$2,196.82	
Foreign and Domestic Commerce	1,615.25	
Bureau of Standards	2,656.47	
Steamboat-Inspection Service	39.42	
Bureau of Navigation	6,416.36	
Bureau of the Census	5,337.65	
Bureau of Fisheries	5,305.93	
Coast and Geodetic Survey	28,320.10	
Bureau of Lighthouses	113,544.85	
		165,432.85
Printing and binding		399,999.47
Total		11,749,763.73

MISCELLANEOUS RECEIPTS, FISCAL YEAR 1915.

Coast and Geodetic Survey: Sale of charts, publications, old property, etc.		$16,841.16
Bureau of Standards:		
Sale of Government property	$81.12	
Standardizing and testing weights	14,355.62	
		14,436.74
Steamboat-Inspection Service: Sale of condemned property, etc.		113.50
Bureau of the Census: Sale of publications, etc.		313.00
Bureau of Lighthouses: Sale of public property, rentals, etc.		19,178.59
Office of the Secretary: Sale of condemned property, etc.		2,342.59
Bureau of Navigation:		
Sale of public property	$21.95	
Annual yacht tax	37,976.30	
Tonnage tax	1,315,425.30	
Navigation fines	41,518.24	
Navigation fees	142,446.37	
Deceased passengers	240.00	
		1,537,628.16

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Bureau of Fisheries:		
Sale of condemned property, etc.	$3,785.87	
Sale of 9 pairs breeding foxes	1,838.00	
Property sold, Pribilof Islands, Alaska	6,533.33	
		$12,157.20
Total		1,603,010.94

The following unexpended balances of appropriations were turned into the surplus fund June 30, 1915, in accordance with the act of June 20, 1874 (18 Stat., 110–111):

Salaries, Office of Secretary of Commerce and Labor, 1913	$5,990.46
Rent, Department of Commerce and Labor, 1913	998.00
Contingent expenses, Department of Commerce and Labor, 1913	143.10
Salaries, Bureau of the Census, 1913	19,733.11
Expenses of the Thirteenth Census, 1913	2,590.62
Temporary clerks, Bureau of the Census, 1913	3,805.34
Collecting statistics, Bureau of the Census, 1913	872.95
Cotton statistics, Bureau of the Census, 1913	1,453.33
Tobacco statistics, Bureau of the Census, 1913	.17
Rent, Bureau of the Census, 1913	1,080.00
Tabulating machines, Bureau of the Census, 1913	106.78
Salaries, Bureau of Foreign and Domestic Commerce, 1913	274.97
Salaries, Bureau of Manufactures, 1913	198.95
Salaries, Bureau of Statistics, 1913	244.23
Collecting statistics relating to commerce, 1913	54.45
Collating tariffs of foreign countries, 1913	20.25
Promoting commerce, Department of Commerce and Labor, 1913	1,837.12
Salaries, Office of Supervising Inspector General, Steamboat-Inspection Service, 1913	69.44
Salaries, Steamboat-Inspection Service, 1913	1,649.72
Clerk hire, Steamboat-Inspection Service, 1913	1,284.11
Contingent expenses, Steamboat-Inspection Service, 1913	5,345.68
Salaries, Bureau of Navigation, 1913	521.81
Salaries, Shipping Service, 1913	2,977.84
Clerk hire, Shipping Service, 1913	1,536.03
Contingent expenses, Shipping Service, 1913	9.28
Instruments for measuring vessels and counting passengers, 1913	2.63
Enforcement of navigation laws, 1913	882.44
Enforcement of wireless-communication laws, 1913	252.25
Salaries, Bureau of Standards, 1913	14,099.71
Equipment, Bureau of Standards, 1913	967.44
General expenses, Bureau of Standards, 1913	422.97
Improvement and care of grounds, Bureau of Standards, 1913	13.19
Current meter testing tank, Bureau of Standards, 1913	3.02
Investigating effects of electric currents, Bureau of Standards, 1913	75.97
Refrigeration constants, Bureau of Standards, 1913	116.52
Testing machines, Bureau of Standards, 1913	161.32
Testing structural materials, Bureau of Standards, 1913	297.22
Salaries, Coast and Geodetic Survey, 1913	6,132.86
Party expenses, Coast and Geodetic Survey, 1913	6,409.08
General expenses, Coast and Geodetic Survey, 1913	451.18
Pay, etc., of officers and men, vessels, Coast Survey, 1913	4,864.16
Repairs of vessels, Coast Survey, 1913	1,509.45

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Repair of steamer *Pathfinder*, Coast Survey	$288.16
Salaries, Bureau of Lighthouses, 1913	503.64
General expenses, Lighthouse Service, 1913	32,728.14
Salaries, keepers of lighthouses, 1913	21,156.01
Salaries, lighthouse vessels, 1913	27,326.42
Salaries, Lighthouse Service, 1913	17,859.81
Storehouses for oil	10.98
Monhegan Island Light Station, Me	1,822.43
Point Judith Lighted Buoy, R. I	534.31
Negro Point Light Station, N. Y	2,649.08
Staten Island Lighthouse Depot, N. Y	23.26
Brandywine Shoal Light Station, Del	39.66
Cape Fear River lights, N. C	126.73
Lincoln Rock Light Station, Alaska	225.51
Tender for engineer, third lighthouse district	272.15
Salaries, Bureau of Fisheries, 1913	18,273.15
Miscellaneous expenses, Bureau of Fisheries, 1913	8,477.90
Payments to Great Britain and Japan	20,000.00
Protecting seal fisheries of Alaska	240.41
Protecting seal and salmon fisheries of Alaska, 1913	1,893.14
Protecting the sponge fisheries, 1913	3,424.45
Steamer *Albatross*, repairs	147.70
Total	247,482.22

Personnel.

During the year the personnel of the Department has been reduced by the transfer of the Bureau of Corporations to form the nucleus of the force of the Federal Trade Commission, authorized by the act approved September 26, 1914. The Commission was formally organized March 16, 1915, on which date the Bureau of Corporations ceased to exist and the following force was transferred:

Statutory:		
Clerical employees	56	
Subclerical employees	5	
		61
Nonstatutory:		
Special examiners	7	
Special attorneys	14	
Special agents	58	
		79
Total		140

The former Commissioner of Corporations was appointed a member of the Commission.

A permanent addition to the personnel of the Department was made by the appointment of a force of inspectors whose duty is to enforce, under the direction of the Bureau of Navigation, the laws to prevent the overcrowding of passenger and excursion vessels. By legislation enacted July 29, 1914, this work was

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transferred from the Treasury Department and during the balance of the fiscal year 1915 had been carried out by a temporary force. In order, however, to select a satisfactory permanent force, examinations were held by the Civil Service Commission and the persons appointed selected from the registers established therefrom. At the end of the fiscal year this force consisted of 43 permanent and 15 temporary inspectors.

The accompanying table shows by bureaus the number of permanent positions in the Department on July 1, 1915, and the increase or decrease in each bureau as compared with July 1, 1914. The figures do not include temporary appointments, nor do they include the following appointments or employments not made by the head of the Department: Persons engaged in rodding, chaining, recording, heliotroping, etc., in field parties of the Coast and Geodetic Survey; temporary employments in field operations of the Bureau of Fisheries; mechanics, skilled tradesmen, and laborers employed under authority of Schedule A, Subdivision I, section 12, of the civil-service rules in the Lighthouse Service. Enlisted men on vessels of the Coast Survey in the Philippines, paid by the insular government of the Philippine Islands, are also excluded. The total of these excluded miscellaneous employments and enlistments is approximately 6,117. At the close of the fiscal year there were 966 employees in the service of the Department serving under temporary appointment or employment.

Bureau.	Statutory.	Non-statutory.	Total.	In District of Columbia.	Outside District of Columbia.	Increase (+) or decrease (−).
Office of the Secretary	162	.....	162	162	.....	+ 36
Bureau of the Census	569	710	1,279	[a] 608	[b] 671	− 98
Bureau of Foreign and Domestic Commerce	88	83	171	108	63	+ 51
Bureau of Standards	239	145	384	331	53	+ 46
Bureau of Fisheries	398	21	419	76	343	+ 22
Bureau of Lighthouses	56	5,736	[c] 5,792	41	5,751	+172
Coast and Geodetic Survey	255	488	743	[a] 271	472	+ 15
Bureau of Navigation	37	132	169	30	139	+ 68
Steamboat-Inspection Service	201	69	270	10	260	+ 5
Total	2,005	7,384	9,389	1,637	7,752	[d] +317

[a] Employees engaged in work in the field for a part of each year, with headquarters in Washington, are treated as within the District of Columbia.

[b] Does not include 634 temporary special agents, employed in connection with the census of manufactures, on duty at the close of June 30, 1915.

[c] Includes the following positions, appointment to which is not made by the head of the Department: 603 (292 classified competitive and 311 classified excepted) mechanics, skilled tradesmen, and laborers employed in field construction work in the Lighthouse Service and work of a similar character at the general lighthouse depot at Tompkinsville, N. Y.; 1,546 (unclassified) laborers in charge of post lights; and 1,128 (unclassified) members of crews of vessels.

[d] Not including the loss of 142 positions by reason of transfer of the Bureau of Corporations to the Federal Trade Commission.

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The following table gives a summary of the changes in the personnel of the Department during the fiscal year ended June 30, 1915:

APPOINTMENTS, PROMOTIONS, AND REDUCTIONS.

Bureau.	Appointments.[a]						Promotions.	Reductions.
	Permanent.				Temporary.	Grand total.		
	Competitive.	Excepted.	Unclassified.	Total.				
Office of the Secretary	33	.....	15	48	7	55	12	.....
Bureau of the Census	49	.....	205	254	1,361	1,615	114	3
Bureau of Corporations[b]	8	8	.....	16	1	17	44	.....
Bureau of Foreign and Domestic Commerce	36	56	2	94	61	155	68	11
Bureau of Standards	81	.....	2	83	29	112	112	1
Bureau of Fisheries	36	8	23	67	13	80	38	6
Bureau of Lighthouses	236	42	1	279	91	370	345	96
Coast and Geodetic Survey	37	11	3	51	27	78	79	2
Bureau of Navigation	57	5	1	63	59	122	12	.....
Steamboat-Inspection Service	13	.....	.....	13	6	19	14	4
Total	586	130	252	968	1,655	2,623	838	123

SEPARATIONS AND MISCELLANEOUS CHANGES.

Bureau.	Separations.[c]						Miscellaneous changes.[d]
	From permanent positions.				From temporary positions.	Grand total.	
	Competitive.	Excepted.	Unclassified.	Total.			
Office of the Secretary	26	.....	8	34	6	40	15
Bureau of the Census	73	.....	228	301	770	1,071	82
Bureau of Corporations[b]	5	1	1	7	.....	7	.....
Bureau of Foreign and Domestic Commerce	9	22	2	33	57	90	143
Bureau of Standards	37	.....	3	40	25	65	37
Bureau of Fisheries	34	8	22	64	19	83	27
Bureau of Lighthouses	228	28	.....	256	97	353	93
Coast and Geodetic Survey	34	5	3	42	19	61	26
Bureau of Navigation	12	5	.....	17	53	70	18
Steamboat-Inspection Service	15	.....	.....	15	6	21	4
Total	473	69	267	809	1,052	1,861	445

[a] Includes appointments of the following character: Presidential, by selection from civil-service certificates, under Executive order, to excepted positions, by reinstatement, and by reason of transfer within the Department or from other departments or independent establishments.

[b] The Bureau of Corporations was abolished Mar. 15, 1915, under the provisions of the act approved Sept. 26, 1914 (Public No. 203), and the personnel thereof was transferred to and became a part of the Federal Trade Commission Mar. 16, 1915.

[c] Includes separations by reason of resignations, discontinuances, removals, deaths, transfers within the Department, and transfers from the Department to other departments or independent establishments.

[d] Includes reappointments by reason of change of station, name, designation, or appropriation, extensions of temporary appointments, changes from temporary to permanent status, etc.

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During the fiscal year 1915 the following presidential appointments were made:

Position.	Compensation.	Authority.
Director of the Census [a]	$6,000	32 Stat., 51.
Chief of Bureau of Foreign and Domestic Commerce [b]	6,000	Acts Aug. 23, 1912, and July 16, 1914.
(First) Assistant Chief of Bureau of Foreign and Domestic Commerce. [c]	3,500	Do.
(Second) Assistant Chief of Bureau of Foreign and Domestic Commerce. [d]	3,000	Do.
Deputy Commissioner, in the Bureau of Fisheries [e]	3,500	32 Stat., 1102.
Superintendent of the Coast and Geodetic Survey [f]	6,000	25 Stat., 949.

[a] Appointment confirmed by the Senate Mar. 3, 1915, and appointee commissioned Mar. 5, 1915, effective Mar. 16, 1915.

[b] Appointment confirmed by the Senate Oct. 1, 1914, and appointee commissioned Oct. 7, 1914, effective Oct. 5, 1914.

[c] Appointment confirmed by the Senate July 29, 1914, and appointee commissioned July 31, 1914, effective on July 31, 1914, by promotion from (Second) Assistant Chief of Bureau of Foreign and Domestic Commerce.

[d] Appointment confirmed by the Senate July 30, 1914, and appointee commissioned Aug. 5, 1914, effective Aug. 5, 1914. Filled by promotion of classified competitive employee in the same Bureau.

[e] Commissioned under a recess appointment Mar. 11, 1915, effective Apr. 15, 1915. Filled by promotion of classified competitive employee in the same Bureau.

[f] Commissioned under a recess appointment Mar. 11, 1915, effective Apr. 15, 1915. Filled by promotion and transfer of a presidential appointee from another bureau.

The Department's policy of filling vacancies by promotion, so far as practicable, instead of by transfer from other departments, is proving an incentive to increased efficiency. Promotion within the Department inspires the working force with the sense that their interests are considered and each employee knows that by faithful service he will win a fair chance at such opportunity as may arise. It is the aim of the Department to admit employees to the lower grades and to advance them according to the results produced. In bureaus where scientific and technical qualifications are required it is impossible to lay down an arbitrary rule, but it is recognized by officers and employees of the Department that this definite policy exists and that only special circumstances will warrant action to a contrary effect.

On September 21, 1915, at the request of the Public Health Service, a statement was prepared showing the total and average amount of *sick* leave taken during the calendar year 1914 by employees of the Department in the District of Columbia, arranged according to sex. This statement showed the following facts:

	Male.	Female.	All employees.
Total number of employees	1,115	331	1,446
Total number of days taken	5,509	3,273.5	8,782.5
Average number of days taken per employee	4.94	9.89	6.07

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A statement was also prepared, from data already available, showing the total and average amount of *annual* and *sick* leave, stated separately and together, taken during the calendar year 1914 by employees of the Department in the District of Columbia, arranged according to sex. This statement shows the facts to be as follows:

	Male.	Female.	All employees.
Total number of employees	1,115	331	1,446
Total number of days taken:			
Annual	30,927	9,701	40,628
Sick	5,509	3,273.5	8,782.5
Average number of days taken per employee:			
Annual	27.74	29.31	28.10
Sick	4.94	9.89	6.07

In view of the importance of securing, for the field work of the Bureau of Foreign and Domestic Commerce, persons possessing suitable qualifications for the positions of commercial and special agent, which are exempt from the competitive requirements of the civil-service rules and regulations, the Department has deemed it advisable to recognize the advantages of an appropriate examination test and has adopted the policy that selection for such appointments shall be made only after the person selected has fully demonstrated the possession of the exceptional qualifications needed. These examinations are conducted under the joint supervision of the Civil Service Commission and the Department.

The Department has endeavored, so far as is possible without manifest detriment to the service, to protect the aged employee. There have, however, been occasional necessary reductions and dismissals of superannuated Government employees. Meanwhile action on the question of providing for the retirement of superannuated clerks has not made apparent advance with those by whom the matter must ultimately be settled. Separations from the service of such employees by death, resignation, and from other causes are of frequent occurrence, but the superannuated employee is still found on the pay roll. The removal of such from the list of active employees would add to the average product of the remaining employees, would give young, ambitious, and deserving employees greater opportunity for advancement, and would generally improve the value of the Government clerk and the tone of the service.

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The act of January 16, 1883, provides that appointments to the civil service of the Government shall be apportioned among the several States and Territories according to population "so far as may be consistent with the interests of the service." This may be construed as authorizing departure from the apportionment principle when it is manifest that by doing so a better result is to be had. While of late years the Civil Service Commission has made modifications in the order of certifying eligibles which show marked progress toward greater efficiency, they have shown hesitation about utilizing the latitude allowed by the law by deviating from the apportionment principle when manifestly such action would be justified. To illustrate the disadvantages of the policy in force, highly efficient candidates from Maryland, Virginia, and the District of Columbia are practically excluded from consideration for certain positions and are not considered for appointment while those of much lower qualifications are presented for selection. An eligible with a rating of 70 per cent from certain States must be and is considered before an eligible from the States and the District named with a rating of 95 per cent. Again, the policy which prevents the promotion of the messenger boys to clerical grades deprives the Government of the services of those who have served apprenticeship and who in consequence must prove of greater value to the service than those without that experience.

Printing and Binding.

The Division of Publications is charged with the expenditure of the printing and binding allotment of the Department. This involves conducting the business of the Department with the Government Printing Office, and general supervision over all printing (including editing and preparing copy), illustrating, and binding for the Department, and keeping records of expenditures and liabilities. The Division has in charge also the distribution of publications; the maintenance of mailing lists; the operation of duplicating, addressing, and mailing equipment; the advertising done by the Department; and the correspondence which these duties entail.

The allotment to the Department for printing and binding during the fiscal year 1915 was $400,000. Of this sum $399,999.47 was expended, leaving an unused balance on June 30 of 53 cents. The decrease in expenditures in 1915 compared with 1914 was $10,701.30 (or 2.6 per cent), the allotment in 1914 being $441,000 and the expenditures $410,700.77.

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The estimated cost of unbilled and uncompleted work of the Department at the Government Printing Office on July 1, 1915, was $51,948.39.

During the year the Department issued on the Public Printer 3,091 requisitions for printing and binding, compared with 3,084 in 1914, an increase of 7. In 1915, however, requisitions were in many cases consolidated where work was identical in character, which reduced the number of requisitions, saved clerical work in preparation and recording, and reduced the cost of the printing and binding. Of the requisitions issued in 1915 there remained at the close of the fiscal year 436 upon which deliveries of completed work had not been made, compared with 355 in 1914 and 344 in 1913.

The following table shows the cost of printing and binding for each of the bureaus, offices, and services of the Department during the fiscal years 1914 and 1915, together with the increase or decrease for each bureau, office, and service and the estimated cost of the work on hand but not completed June 30, 1915:

Bureau, office, or service.	Cost of work delivered.		Increase (+) or decrease (−).		Estimated cost of work not completed June 30, 1915.
	1914	1915	Cost.	Per cent.	
Office of the Secretary (Secretary, Assistant Secretary, Solicitor, Chief Clerk, and Division of Publications)	$12,655.94	$19,537.58	+$6,881.64	+54.37	$2,239.93
Appointment Division	383.58	379.22	− 4.36	− 1.14	.....
Disbursing Office	698.09	412.18	− 285.91	−40.96	156.39
Division of Supplies	505.43	686.04	+ 180.61	+35.73	42.70
Bureau of the Census	110,758.32	122,302.82	+11,544.50	+10.42	11,169.58
Coast and Geodetic Survey	28,837.49	26,345.70	− 2,491.79	− 8.64	5,828.05
Bureau of Corporations	10,468.46	[a] 17,000.00	.....	.....	.....
Bureau of Fisheries	12,687.49	15,916.27	+ 3,228.78	+25.45	1,678.14
Bureau of Foreign and Domestic Commerce	132,039.95	103,229.74	−28,810.21	−21.82	11,257.08
Bureau of Lighthouses	25,560.31	24,428.15	− 1,132.16	− 4.43	3,996.32
Lighthouse Service	7,298.93	5,853.89	− 1,445.04	−19.80	1,735.97
Bureau of Navigation	12,473.34	14,183.91	+ 1,710.57	+13.71	1,558.77
Shipping Service	2,646.77	2,272.30	− 374.47	−14.15	1,251.59
Radio Service	893.83	705.67	− 188.16	−21.05	94.37
Bureau of Standards	28,033.31	24,876.38	− 3,156.93	−11.26	4,312.40
Office of the Supervising Inspector General, Steamboat-Inspection Service	2,637.22	2,801.64	+ 164.42	+ 6.23	6.51
Steamboat-Inspection Service	8,768.90	9,780.49	+ 1,011.59	+11.54	2,731.06
Customs Service	13,353.41	9,287.49	− 4,065.92	−30.45	3,889.53
Total	410,700.77	399,999.47	−10,701.30	− 2.60	51,948.39

[a] Includes $4,613.24 expended by the Department and $12,386.76 transferred to the Federal Trade Commission on Mar. 15, 1915, in accordance with the requirement of the act creating the Commission, approved Sept. 26, 1914.

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I again call attention to the fact that though the work of the Department has expanded its expenditures for printing and binding have remained practically stationary, as is shown by the following statement. The figures prior to 1913 include expenditures for bureaus and services transferred to the Department of Labor by the act of March 4, 1913, but do not include those for the Bureau of the Census, which was formerly provided for by separate allotments or appropriations. The insufficiency of the Department's allotment for 1915 is evidenced by the unused balance of only 53 cents, though at the end of the year there was in hand uncompleted work which will cost approximately $52,000, and which constitutes a liability against the allotment for 1916.

Fiscal year.	Allotment.	Expenditures.	Unused balance.	Cost of work not completed June 30.
1907	$375,000.00	$332,185.05	$42,814.95	$34,749.24
1908	375,000.00	342,962.36	32,037.64	47,055.59
1909	375,000.00	374,939.91	60.09	29,139.26
1910	[a] 376,337.43	[a] 361,530.43	14,807.00	42,535.93
1911	[b] 381,500.00	[b] 375,575.02	5,924.98	46,173.12
1912	375,000.00	374,995.64	4.36	43,956.76
1913	[c] 329,978.06	[c] 329,974.92	3.14	36,686.50
1914	441,000.00	410,700.77	30,299.23	49,827.74
1915	400,000.00	399,999.47	.53	[d] 51,948.39

[a] Includes $1,337.43 expended for supplies furnished the Bureau of the Census, for which the Department's allotment was reimbursed.

[b] Includes a special appropriation of $6,500 for the printing of the World Trade Directory. The entire sum was expended for the publication.

[c] Includes $6,728.06 for printing done for the Bureau of the Census (publishing statistics relating to cotton and tobacco) and the Bureau of Navigation (Radio Service), for which the Department's allotment was reimbursed.

[d] Estimated.

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The following statement shows the amount and cost of each class of work called for by requisitions on the Public Printer during the fiscal year 1915, and affords a comparison with the amount and cost of these classes during the preceding fiscal year:

Class.	1914	1915	Increase (+) or decrease (−).	
	Number.	*Number.*	*Number.*	*Per cent.*
Blank forms	14,301,618	15,559,663	+1,258,045	+ 8.80
Reports, pamphlets, etc	7,634,930	3,370,410	[a] −4,264,520	− 55.86
Letterheads	1,789,000	3,427,500	+1,638,500	+ 91.59
Envelopes	347,250	153,500	− 193,750	− 55.80
Circulars, notices, and summaries	729,875	541,200	− 188,675	− 25.85
Index cards	1,620,200	1,220,700	− 399,500	− 24.66
Guide cards and folders	152,700	411,650	+ 258,950	+169.58
Memorandum sheets	1,525,000	5,678,000	+4,153,000	+272.33
Blank books	13,355	28,597	+ 15,242	+114.13
Miscellaneous books (binding)	4,530	3,945	− 585	− 12.91
	Cost.	*Cost.*	*Cost.*	*Per cent.*
Blank forms	$45,226.19	$51,225.93	+$5,999.74	+ 13.27
Reports, pamphlets, etc	338,247.73	301,666.94	−36,580.79	− 10.81
Letterheads	2,962.95	5,364.20	+ 2,401.25	+ 81.04
Envelopes	311.61	265.96	− 45.65	− 14.65
Circulars, notices, and summaries	3,594.09	2,299.90	− 1,294.19	− 36.01
Index cards	1,339.47	1,104.74	− 234.73	− 17.52
Guide cards and folders	740.27	1,910.98	+ 1,170.71	+158.15
Memorandum sheets	1,214.55	3,275.18	+ 2,060.63	+169.66
Blank books	10,591.99	11,296.06	+ 704.07	+ 6.65
Miscellaneous books (binding)	5,890.27	8,481.08	+ 2,590.81	+ 43.98
Miscellaneous	581.65	721.74	+ 140.09	+ 24.08
Transferred to Federal Trade Commission (Bureau of Corporations) on Mar. 15, 1915	.....	12,386.76	.....	.....
Total	410,700.77	399,999.47	−10,701.30	− 2.60

[a] This decrease was due principally to the reduction of the edition of Commerce Reports on July 1, 1914, from 20,000 to 5,000 daily.

During the fiscal year 1915 the Department issued 1,048 publications, compared with 1,054 for the same bureaus and offices during the fiscal year 1914. The publications issued in 1915 contained a total of 63,851 printed pages, compared with 54,768 in 1914, and there were printed of them for the Department a grand total of 3,777,895 copies, against 8,586,605 in the preceding year, a decrease of 4,808,710 copies. This decrease was due to the smaller editions printed of many of the Department's periodical publications, especially daily Commerce Reports, of which there were 4,180,800 fewer copies printed in 1915 than in 1914.

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The publication work of each bureau of the Department for the past two fiscal years is summarized in the following table:

Bureau.	Publications.		Pages.		Copies printed for Department.		Cost.	
	1914	1915	1914	1915	1914	1915	1914	1915
Office of the Secretary....	56	64	2,090	2,237	197,050	157,250	$6,435.72	$6,055.39
Bureau of the Census.....	198	138	12,976	19,937	1,056,950	524,625	98,306.41	97,830.49
Coast and Geodetic Survey.....	25	29	4,674	3,197	55,125	55,060	32,782.08	21,630.72
Bureau of Corporations...	15	10	3,136	2,550	16,990	24,100	3,672.45	14,319.65
Bureau of Fisheries.....	53	57	2,516	3,159	90,100	68,200	10,496.77	11,902.88
Bureau of Foreign and Domestic Commerce...	425	494	16,220	18,708	6,242,470	2,108,460	121,820.68	98,937.71
Bureau of Lighthouses...	108	87	3,432	3,548	279,020	258,300	25,791.17	25,188.70
Bureau of Navigation....	19	17	2,036	2,523	42,100	55,900	11,817.41	12,154.79
Bureau of Standards.....	145	137	6,895	6,662	129,300	153,400	19,553.30	19,408.79
Steamboat-Inspection Service.....	10	15	793	1,330	477,500	372,600	7,295.61	8,511.22
Total.....	1,054	1,048	54,768	63,851	8,586,605	3,777,895	[a]337,971.60	[a]315,904.34

[a] Figures relate to publications actually delivered to the Department during the year; consequently they do not agree with similar figures in a preceding table giving the cost of work done by the Government Printing Office during the fiscal year. Frequently the cost of a publication is charged against allotments or two or more fiscal years.

During the year 2,523,994 publications and printed circulars of the Department were distributed to the public, as compared with a total of 7,035,029 during the fiscal year 1914, a decrease of 4,511,035. This decrease was due in part to revisions of mailing lists, which resulted in the removal of a large number of names, but chiefly to the Department's effort to curtail the promiscuous free distribution of its publications and to place them on a sales basis. There was a decrease in 1915 compared with 1914 of the daily Commerce Reports (formerly Daily Consular and Trade Reports), which was on July 1, 1914, placed on a subscription basis, of 4,180,800 copies formerly printed for free distribution. Of the total number of publications and circulars distributed in 1915, 2,086,815 were wrapped and mailed by the office of the Superintendent of Documents and 437,179 by the Division of Publications. Those wrapped and mailed by the Superintendent of Documents comprised a mailing-list distribution of 1,860,033 and a distribution in response to individual requests of 226,782.

The Department during the year received and acted on 79,738 miscellaneous requests, calling for 385,208 copies of publications. This was an average of 261 requests and 1,279 publications for each working day.

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The Department during the year went further than heretofore in reducing the editions of many of its publications and limiting their free distribution to well-defined public or quasi-public recipients. Experience has demonstrated that the promiscuous free distribution of Government publications is extremely wasteful. The Superintendent of Documents maintains sales stocks of nearly all of them and the Department has cooperated to the fullest extent with him in making the public familiar with the titles, contents, and prices of its publications. This cooperation has borne fruit abundantly, and there is increasing evidence that individuals are willing to pay the nominal charges for Government publications, which are based only on the cost of printing. The general adoption of the sales method of distributing public documents would be a practical method of curtailing extravagance in public printing and binding.

Sales by the Superintendent of Documents during each of the past five years of publications issued by the Department are summarized in the following statement:

Year.	Miscellaneous sales.		Subscriptions.		Total receipts.
	Copies.	Receipts.	Number.	Receipts.	
1911	9,395	[a]$14,961.85	[b]	[b]	[a]$14,961.85
1912	[c]30,775	[d] 5,963.19	539	$2,749.75	[d] 8,712.94
1913	11,248	[e] 4,313.20	572	1,958.55	[e] 6,271.75
1914	41,561	8,182.95	2,329	5,789.80	13,972.75
1915	[f]44,488	[f] 10,033.05	5,705	12,674.55	[f] 22,707.60

[a] Includes $13,255 received from sales of the 1911 World Trade Directory.

[b] The amount received through subscriptions in 1911, the first year there was any distribution on that basis, was only $27.10.

[c] Includes 17,150 copies of two publications sold at a nominal price for free redistribution.

[d] Includes $2,450 received from sales of the 1911 World Trade Directory.

[e] Includes $1,090 received from sales of the 1911 World Trade Directory.

[f] Preliminary figures.

It will be noted from the foregoing statement that during the fiscal year ended June 30, 1915, there were 44,488 copies of the Department's publications distributed by the Superintendent of Documents through the medium of miscellaneous sales. For the same period 1,348,741 copies were distributed by annual subscription, making a total sales distribution for the year of 1,393,229 copies. Receipts from these sales and subscriptions increased from $13,972.75 in 1914 to $22,707.60 in 1915, or more than 62 per cent.

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Three years ago there was established in the Division of Publications an equipment for duplicating typewritten letters and documents. This equipment has been of very practical service to the bureaus and offices of the Department in obtaining duplicates of documents quickly and in large quantities, and the plant has been utilized extensively, as is shown by the following summary of work turned out by the machines employed:

Year.	Requisitions filled.	Pages duplicated.	Copies printed.
1913	600	882	677,746
1914	1,591	3,150	1,176,366
1915	3,169	7,142	3,816,937

The figures in the table show increases for 1915 over 1914 as follows: Requisitions filled, 1,578, or 99 per cent; pages duplicated, 3,992, or 126 per cent; copies printed, 2,640,571, or 225 per cent.

The Department has adopted the practice of giving wide publicity, through newspaper advertisements, to proposed contracts for materials and supplies. Large sums are expended each year for such materials and supplies and the publicity given has resulted in greater competition and more satisfactory contracts than formerly. The cost of the advertising involved is comparatively insignificant, as is shown by the following statement:

Year.	Advertisements inserted.	Authorities to publish issued.	Insertions authorized.	Total cost.
1910	49	238	715	$1,721.36
1911	26	86	260	439.40
1912	27	112	295	531.38
1913	33	153	434	660.46
1914	159	526	1,408	1,968.41
1915	226	797	2,143	3,108.83

Work of the Solicitor's Office.

During the fiscal year ended June 30, 1915, 244 contracts, totaling $1,256,773, together with 22 contracts of indeterminate amounts; 74 leases, amounting to $130,844; 19 revocable licenses, amounting to $1,223; insurance policies in the sum of $135,000; deeds involving payments of $6,289; and 215 bonds, amounting to $643,694, were examined (approved, disapproved, drafted, redrafted, or modified).

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The number of legal opinions rendered, formal and informal (memorandum), numbered 323. In addition to the above, 1,066 miscellaneous matters, embracing everything submitted for the advice or suggestion of the Solicitor, or for the formulation of departmental action, not included in the foregoing items, were handled by this Office.

This completes the usual report for the Office of the Secretary. Certain important questions of policy remain to be briefly considered before proceeding to discuss the separate services. To these questions I ask special attention.

Foreign Unfair Competition.

"Unfair competition" is forbidden by law in domestic trade, and the Federal Trade Commission exists to determine the facts and take steps to abate the evil wherever found. The door, however, is still open to "unfair competition" from abroad which may seriously affect American industries for the worse. It is not normal competition of which I speak, but abnormal. It is a destructive type of the industrial struggle, intended to put out of being the forces opposed to it that the victor may exploit the field at will. The methods used are not those of legitimate commerce, but those of commercial offense. They aim not at development, but at conquest. When the war shall close, the public control of railways in foreign lands, the semiofficial chambers of commerce, the publicly fostered organizations which control great industries in some countries, will all exist and will all be used in an effort to recover lost commerce. The growth in the United States of industries which may menace large markets heretofore controlled from abroad will not be permitted if public and semipublic forces acting together in foreign countries can prevent it. The outreach of American industries, nay their very existence in our own land in some cases, will be resisted to the full and every stratagem of industrial war will be exerted against them. Expecting this, we must prepare for it. If it shall pass beyond fair competition and exert or seek to exert a monopolistic power over any part of our commerce, we ought to prevent it.

So few would question the duty of restraining by means of the public power the unfair foreign competition of which I speak that the question may be said not to be whether we shall prevent such attacks but how they shall be prevented, while welcoming, indeed promoting, that normal ebb and flow of legitimate commerce

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between our land and all others which will provide for our people the security against exaction which is insured by reasonable competition. In my judgment the matter is one which may more wisely be treated as an attempted wrong to be forbidden than as an economic matter which needs to be restrained. I should prefer, therefore, to deal with it by a method other than tariffs, classing it rather as an offense similar to the unfair domestic competition we now forbid. It seems possible that by using the existing machinery of the Treasury Department and the Department of Justice we may restrain this foreign "unfair competition" on both sides of the sea. I recommend, therefore, that such legislation be enacted as will give to the foreign representatives of the above-named departments such added powers and increased personnel as they may need for this purpose, and that it be enacted if possible that merchandise sold in "unfair competition" or under circumstances which tend to create a monopoly in behalf of the foreign producer in American markets shall be forfeited. I also recommend that legislation supplemental to the Clayton Antitrust Act be enacted which shall make it unlawful to sell or purchase articles of foreign origin or manufacture where the prices to be paid are materially below the current rates for such articles in the country of production or from which shipment is made, in case such prices substantially lessen competition on the part of the American producers or tend to create a monopoly in American markets in favor of the foreign producer, and that it be made unlawful for any person to buy, sell, or contract for the sale of articles of foreign origin, or to fix a price for same or to make a rebate upon such price, conditioned upon the purchaser thereof not using or dealing in wares produced or sold by the competitors of the manufacturer or seller, where the effect is to substantially lessen competition in the production in the United States of such articles, or tends to create a monopoly in the sale of such articles in American markets in favor of a foreign producer.

Cooperation in Foreign Trade.

I deem it of special importance that business concerns should be allowed to cooperate in foreign trade. The present law plays into the hands of the larger concerns and shuts out small ones from important markets. It may be said that small manufacturers could not in any case successfully enter the foreign field. This, however, ignores the fact that in many lines and specialties there are producers of moderate size abundantly able to compete as re-

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gards the cost and character of their products but unable to assume alone the considerable expenditure over a continued period that would be required to obtain a firm foothold in foreign markets for their somewhat limited products. Such a concern ought to be permitted to cooperate with another in similar or different lines in order to share the expense of introducing their goods abroad. There are lines of industry classified under one head in which the individual concerns may each make separate specialties though their general products are in common. Provision should be made whereby such concerns may, with due safeguards against monopoly, cooperate in the foreign field. To refuse this for any fancied fear of monopoly is to say that the large concerns shall alone hold the lucrative foreign markets and that the far larger number of smaller houses with their many employees shall be shut out from them. Such a policy can commend itself to no one. The whole matter should be placed under the supervision of the Federal Trade Commission and should be subject to full publicity. Either of these safeguards should be sufficient; both of them will certainly be so. It is, of course, not intended that this cooperation shall extend into the domestic field. It is as necessary that it shall exist as regards the foreign field as it is important that it should not go to excess in the domestic one. One should be done; the other avoided. Under the supervision of the Federal Trade Commission the necessary good can be accomplished and the unnecessary evil can be prevented.

Cooperation in Establishing Banks Abroad.

It is important that our banks should be permitted to cooperate, subject to the supervision of the Federal Reserve Board, in establishing foreign branches or in owning stocks of banks operating in foreign countries. The present law operates to make it possible only for large banks of great power to undertake the important work of financing American commerce in foreign fields. In other words, the law works in sole favor of the great banks. Great credit is due those American bankers who have taken the first forward steps in establishing foreign branches. They are true pioneers of American commerce abroad. The work, however, is of such national importance that it should not be confined to any one or any few large institutions. It is not for their permanent good that it should be so confined. The country requires not one or a few, but numerous American-owned banks abroad. There are many banks in the United States of less than major size, yet

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abundantly strong. These should be permitted, under proper safeguards, to act jointly in such matters. There could hardly be a single step in the fiscal world which at this time would be more helpful in establishing our commerce abroad on a firm basis. Several strong institutions have signified willingness to cooperate in establishing foreign banks if permission is given them by the law.

This can not be done too soon. Time presses. The hour for movement is now. The currents of the world's trade flow strongly toward America. They may not always so flow. There are those whose interest it will not be to have them flow our way. This is not the occasion for fear lest something happen somewhere and somehow which will not be pleasing to some one, but is the time for action, taking, indeed, every possible thoughtful step to safeguard that action, but remembering that action is the thing needed.

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BUREAU OF FOREIGN AND DOMESTIC COMMERCE.

The former chief of this Bureau, Mr. A. H. Baldwin, resigned, effective on October 4, 1914, to accept the post of commercial attaché at London. Dr. Edward Ewing Pratt was appointed Chief of the Bureau as his successor and took office on October 5, 1914. He found the work of the service established on a solid foundation, upon which is building a structure of great and growing usefulness to the commerce of the United States.

The work of the Bureau of Foreign and Domestic Commerce is necessarily of a missionary character. It partakes of the nature of a commercial reconnoissance. It often precedes the efforts of the regular salesman. Nevertheless, it must be tested by its practical value and can not be called promoting commerce unless actual orders result. While, therefore, it would be a mistake to measure the work wholly by the volume of orders known to have been taken by American manufacturers in a given time as a result of its work, this, nevertheless, is the standard of success toward which we must work and by which, in some measure at least, that work must be tested. When a large foreign order is laid upon the Secretary's desk as a result of the work of the service, when a foreign buyer intending to spend a considerable sum in the United States is, through the work of the service, led to buy twice as many American goods as he had expected to purchase, we think we may justly feel that these are practical evidences of what the business man calls "results." Within a few days of the end of the past fiscal year a representative of a Russian house applied to the Bureau of Foreign and Domestic Commerce to assist him in getting in touch with concerns interested in exporting cotton. Through a confidential circular his presence in New York City was made known, and during a short stay in New York the visitor made his headquarters at the office of our service there and formed connections with American exporters. One of these latter tells us that he has just closed with the party named a five-year contract for 40,000 bales of cotton annually.

We are also informed of several specific instances of large orders, some for a million dollars or more, the information of which was first published in our "Foreign trade opportunities" service. Among these are a railway for the island of Formosa, a capitol at Taihoku, Formosa, and arsenal machinery for Hanyang, China. We

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were recently informed by a large milling concern in the West that about two years ago it formed a business connection with a concern in Turkey through the Bureau and that during the past two years the amount of business done by the American house with this one concern has exceeded $800,000.

Information published as a "Foreign trade opportunity" resulted in a contract for a new telephone system for a city in northern Europe, a contract for a petroleum pipe line in southeastern Europe, and a contract for a public building in the Far East. It would be easy to multiply instances showing the direct results of the effective service of the Bureau, for whose better equipment Congress so wisely provided at its last session.

One single result of the work of a commercial attaché in Europe would many times pay the cost of the entire attaché service for years through the opening of a market for several million tons of American coal annually. Within three hours after we learned from abroad that through the agency of our attaché the door for exporting coal to Spain was open telegrams giving this information were sent by the Bureau to the most important coal producers in the United States, and within three days a letter was received from a prominent American coal producer saying they had already gotten into cable communication with their representatives in Madrid and had a cable order for a considerable quantity of coal.

It is so natural and proper a question as to whether the forward step taken by this service with the approval of Congress in the last year has had practical results that I venture to offer certain correspondence, of which it would be easy to produce many other examples.

The following is from a large machinery manufacturing house:

We have wanted to express to you and the Department at Washington our ideas about the Bureau, and have omitted from doing so because of our hours being too much occupied.

Allow us to thank you for putting us in touch with at least five countries, where we have appointed agents, or had important correspondence, all through the Bureau with little or no cost to us, and also with other concerns which may bring business to a head later on, because our service takes some time to market.

To-day we are working on a cable order, which was started entirely through the "Trade opportunity" system, and which cost us approximately 25 cents postage and a few cables.

Some time ago the writer had the pleasure of talking to a subject of Great Britain who has had a vast experience in foreign commerce, and his words were: "There's no use talking, we are behind the times when it comes to consular service; you Americans have the most efficient system in the world."

We therefore wish to extend our thanks to the Bureau, and beg to state that we appreciate the courtesy afforded us by its New York office.

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The letter which follows is from the commercial agent in charge of the St. Louis office of the service:

In conversation the other day with ———, representing ———, he stated that through a firm in Italy whose name was obtained through a "Foreign trade opportunity" announcement a few years ago, the company had secured a customer who, up to the beginning of the war, had been purchasing between $10,000 and $18,000 worth of shoes annually. It was stated, however, that owing to the unsettled conditions in Italy, business with the firm referred to is practically at a standstill at the present time.

This company follows up the "Foreign trade opportunity" service in a very methodical manner. It does not expect to receive an order from every firm mentioned in the "opportunity." It has been found that the first letter written to many firms is ignored entirely. After sufficient time has elapsed for a reply to be received, the original letter is followed up by another communication, and if no attention is taken of the second letter the name is filed and in six or nine months or a year the correspondence is again revived and a catalogue sent. It is believed that this systematic method of following up the service has had much to do with the satisfactory results obtained.

The following is from a well-known manufacturer in the State of Ohio:

We are pleased to inform you that we are in receipt of another order from Halifax, which was in answer to your "Foreign trade opportunities." This makes the fourth order we have received from this party, and we feel that we are indebted to your Department for the original order.

In the letter which follows the commercial agent in charge of the New York office advises concerning foreign orders obtained through the "Foreign trade opportunity" service:

——— advises that through a name and address connected with a "Foreign trade opportunity" announcement, published about three months ago, they have secured an order for ten safes. * * * The order comes from Maracaibo, and the cash payment is in New York, the safes to be shipped on the next Red D Line boat. The company in Maracaibo has taken the agency for the safes, and it is expected that good business will result.

Mr. ——— states that he has secured business sooner or later from about 20 per cent of the inquiries received through the Daily Consular and Trade Reports. He is doing business with a concern in India which amounts to about $3,000 a month. This connection was made through the "Opportunity" service. He is also getting connections in Costa Rica, which were made in the same manner.

The letter which follows, addressed to the office of the Bureau in Atlanta, Ga., is from a hosiery manufacturer in the State of Tennessee:

We wish to make mention of one success, which we have achieved through the use of your "Trade opportunities." Just yesterday we received an order for about 1,000 dozen from an agent in Santo Domingo, whom we obtained through the use of your "Trade opportunity."

We have also disposed of quite a little of our merchandise to other firms by this same means, and we wish to say that your services have been a material aid to us in building up our foreign business, and you may rest assured that we value it most highly.

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The following is from the general manager of one of the leading coal-mining companies, written from its New York office:

Your letter of April 26, conveying to us for our confidential information and use the substance of certain parts of a report on the private audience which Commercial Attaché C. W. A. Veditz, with the American Ambassador to Madrid, had with the King of Spain, received, and we appreciate your consideration very much. * * * I am sure you will be pleased to know that we are interesting the consumers of coal in Spain in the purchase of our product.

Acting upon your previous advices, we cabled the Minister of State, Madrid, of our desire to establish relations with the Spanish Government and Spanish commercial coal consumers, and promptly received a reply by cable, advising us of certain coal consumers being in the market for a supply of coal, and after some cable correspondence with these consumers *we got a very good order from them*, which we are now filling. Meantime, we are negotiating further sales and hope to be as successful as we were in the first instance.

The letter printed below is from a manufacturing house in Chicago:

We just delivered to a Russian house $2,500 worth of merchandise, and it cost us only 7 cents to get the order, as name was given us by you some time ago. Thank you.

It is a pleasure to know that the merchants and manufacturers of the country are appreciative of the service. They show it in a way which is often pleasantly embarrassing, though calling on us for more and more of that which we would willingly give if we had the force and funds to do so.

It is now the definite policy of the Bureau of Foreign and Domestic Commerce to place in touch with every delegation and official commercial visitor from abroad an officer of the Department speaking the language of the country from which the delegation or visitor comes, in order to assist as fully as possible in developing American commerce from the visit. As an official illustration of the value of this work, the following correspondence with the commissioner of the Spanish Government to develop commerce between Spain and the United States of America may have interest:

NEW YORK, *June 7, 1915.*

SECRETARY OF COMMERCE, *Washington, D. C.*

DEAR SIR: The writer, who intends to sail for Spain on board the Spanish steamship *Manuel Calvo* to-morrow, wishes to express to you, before leaving the United States, my appreciation of assistance rendered me during my sojourn in the United States by the Bureau of Foreign and Domestic Commerce, both in New York and at Washington.

May I ask that you extend my thanks and appreciation of their courtesy and kindness which was shown me to Dr. E. E. Pratt, Mr. E. C. Porter, and Mr. Rose, of the New York bureau, who, on account of his speaking our language fluently, was of very great assistance to me.

I take the liberty at this time to compliment you on the efficiency of these departments, without the assistance of which it would have been very difficult for me to fulfill my duties as commissioner of my Government.

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If it be possible, I would thank you to send me the data which is issued from time to time by your Department relative to the commerce between Spain and the United States.

My address in Madrid is Juan de Mena No. 23, and I assure you that I will be very happy to have the pleasure of greeting you in our country at some future time.

Looking forward to that pleasure, and again thanking you, I am

Yours, very truly,

JOSE DE GOROSTIZAGA.

JUNE 8, 1915.

MY DEAR SIR: Your valued favor of the 7th is received by me to-day, and I regret that it does not give me time to send this to you before you leave the country.

I appreciate for myself and for my associates your thoughtful courtesy in writing so kindly your appreciation of their assistance. I assure you on their behalf that they were more than glad to be of service to you and will continue so to be. I trust, therefore, you will feel free to lay before them through me any further problems or suggestions that may from time to time occur to you. It is my earnest desire to cultivate and improve the relations between your country and our own, seconding in this respect the very courteous expression of His Majesty, your King, kindly communicated by him to our Ambassador and Commercial Attaché Dr. C. W. A. Veditz. I hope it may be your privilege to meet from time to time Dr. Veditz, the commercial attaché, to whom I refer. A letter addressed to him care of the American Embassy at Paris will reach him. He visits Spain from time to time and can there be addressed care of our Embassy at Madrid. He would be glad to be of service to you, and possibly as matters arise you could save time by communicating with him.

The Bureau of Foreign and Domestic Commerce has been instructed to put your name upon their mailing list, that you may be sent the data which they publish. We have also given instructions that the semiannual and monthly catalogues of the Department publications be sent you. In them you may find something from time to time which may be of interest.

Very truly, yours,

WILLIAM C. REDFIELD, *Secretary.*

SR. DON JOSE DE GOROSTIZAGA,
Juan de Mena No. 23, Madrid, Spain.

The Bureau of Foreign and Domestic Commerce maintains branch offices in the cities of New York, Boston, Chicago, St. Louis, Atlanta, New Orleans, San Francisco, and Seattle. These offices are established not only for the cities in which they are located but for the districts about them, in which they serve as the stimulators and developers of foreign and domestic trade. They bring the promotive work of the service into the office and to the desk of the individual manufacturer and merchant. Their value is evidenced by the demand for their services and by the earnest and repeated requests from other important cities for an extension of the service to them, with which invitations it is impossible to comply, for lack of funds. The New York office had 1,566 visitors in the four weeks ended September 28, 1915. On one day there were 104 visitors. The Boston office had 421 visitors that month. Chicago had 530. These eight

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offices distribute information collected by the Bureau from all over the world, and conduct special investigations for the Bureau. They arrange conferences between American consular officers and the special agents of our own service who have returned from abroad and the business men interested in foreign trade in the fields from which these officers come. They aid foreign purchasers in forming desirable connections with American manufacturers and exporters; they confer with commercial organizations and business men in regard to trade conditions at home and abroad. In brief, each office represents in its city and to the district surrounding it the great work which this important service is carrying on through the commercial attachés and the commercial agents and the consular service all around the globe. The commercial agents in charge of these offices notify the business men in their districts of the visits of our officers coming from abroad. They furnish suitable facilities for the display of samples, specifications, and the like. They tell of the coming of important foreign buyers and provide a place of meeting where the American seller and the foreign buyer can get together. They bring the American manufacturer and exporter into direct contact with our returning commercial agents and afford them an opportunity to ask the man who has just visited them direct and pertinent questions concerning the markets visited. The requests for work of this character are so numerous that it is impossible to meet the demand with the force and in the time available. When a foreign buyer visits a city containing a branch office, the buyer is invited to make that office his headquarters during his stay, and the commercial agent renders every assistance possible in placing the purchaser in touch with all parties who can furnish the needed goods. The following telegram addressed to the Secretary of Commerce, dated June 23, 1915, from the representative of the Society of Moscow, who made his headquarters for some time at the branch office in New York, speaks for itself:

Referring to telephone conversation with the Chief of the Bureau of Foreign and Domestic Commerce and the commercial agent in charge of the Bureau's New York office, we respectfully announce the closing of a three to five year contract for the annual movement of American merchandise to Russia up to $2,000,000, made possible by the assistance of the Bureau of Foreign and Domestic Commerce. We express our sincere appreciation.

A representative of a foreign iron and steel concern visited the United States to make purchases. He was primarily inter-

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ested in the products of certain firms in Pennsylvania and Ohio. The commercial agent in charge at Chicago, being an expert in those lines, was instructed to accompany this purchaser and render any assistance in his power. As a result of this visit thus conducted large orders were placed by the buyer, and a letter to the Bureau attested his appreciation of the services rendered by the commercial agent.

The routine work of the New York office for a single recent month also included the receipt of 6,000 letters and the mailing of 5,000 "Foreign trade opportunities." In this single office during the fiscal year five times as many callers were received as during the preceding fiscal year, and three times the volume of correspondence went on.

The service is being extended to what we may call "cooperating branches." When a local commercial organization puts in charge of its export department at least one full-time employee with satisfactory qualifications, the Bureau of Foreign and Domestic Commerce undertakes to supply that organization with all the information furnished its own branch offices. Frequent reports are required in such cases, and to insure uniformity in methods and satisfactory service to the local community each cooperating branch is placed under the general supervision of the manager of the appropriate branch office of the Bureau. The commercial organizations cooperating in this manner with the Bureau of Foreign and Domestic Commerce are the Cleveland Chamber of Commerce, the Cincinnati Chamber of Commerce, the Los Angeles Chamber of Commerce, and the Detroit Board of Commerce. The Philadelphia Chamber of Commerce has been added since the year closed.

Reorganization of Statistical Service.

During the last fiscal year a comprehensive study of the statistical methods affecting the returns of exports and imports was made by Mr. Frank R. Rutter, an Assistant Chief of the Bureau of Foreign and Domestic Commerce, in cooperation with statistical committees appointed by this Department and by the Treasury Department. Perhaps the most striking result has been the installation of tabulating machines at the New York Customhouse, where the statistics of exports and imports for the whole country have been tabulated since July 1, 1915. Returns are made out by statistical clerks at the various ports on special forms which are transmitted daily to New York. There the data are trans-

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ferred to punched cards, which are then assorted and tabulated mechanically, and the results are automatically listed. The sheets so printed are then transmitted monthly to the Bureau in two series, the first being confined to the data required for publication in the Monthly Summary of Foreign Commerce and the second, transmitted later, showing full details required for the publication of the annual report.

The advantages of the new system are the prompter returns received from the customhouses, the facilities afforded for showing greater details in the classification, and the elimination of much purely clerical labor, which will permit a more careful scrutiny of the returns and thus insure a higher degree of accuracy. It is not expected that the new system will result in a saving in total outlay. It will, however, it is believed, bring about, without an increase in cost, a larger output of statistical work, and will result in gains both in respect to timeliness and accuracy.

Much greater gain in accuracy can, however, be anticipated from certain changes that are being introduced in customs procedure. In order to make statistics of imports correct from the start, so far as this ideal can be realized, it is proposed to introduce a statistical as well as a fiscal examination of the returns before the entry is accepted from the importer or customs broker.

On the export side much inaccuracy has existed up to the present time. No method has been employed to insure statistical returns in the case of every shipment that leaves the country, and it is therefore impossible to estimate the degree of incompleteness of our published exports. It is known, however, that the total value of our exports has been understated. An agreement has been reached between the two Departments to modify the present practice in respect to export declarations; this change will undoubtedly go a long way, just as far as it is possible to go under existing legislation, to obtain complete returns. After January 1, 1916, no vessel will be allowed to clear until all shippers' declarations have been filed at the customhouse, or, in lieu thereof, a bond has been given to produce the missing declarations within a period of 15 days. A new form of declaration has been provided that will keep strictly confidential the information in respect to value contained on the export declaration, and will enable the original shipper, instead of his agent at the port, to make out the document. This last is important. We need, and should have, a first-hand statement from the man who knows the facts, and the cooperation of the business public to this end is urged.

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Heretofore the manifest required from the carrier, whether railroad or steamboat, has been in the vast majority of cases merely a transcript from the export declarations of the shippers, and for this reason has constituted no real check on the accuracy of the latter. After January 1, 1916, these manifests are to be made up from the records of the carriers themselves, in the case of railroads duplicate copies of the way bills being accepted and in the case of steamships a compilation from the dock sheets. Clerical labor on the part of the carrier will be thus materially lessened and an independent record obtained to serve as a means of verifying the shippers' declarations.

There is an imperative need of a modification of the statistical classification now in use so as to correspond more closely with commercial usage, and to show the details needed by our exporters. The extent to which the classification can be enlarged will depend upon the capacity of the new tabulating machines. The whole subject will be carefully examined by the Bureau during the present fiscal year, and commercial organizations and business men are invited to present their needs to the Bureau for consideration.

In accord with the desire to make the statistical service of greater practical assistance to exporters, it is proposed to change the annual returns from the fiscal year to the calendar year. This change will require new legislation, but it will result in greater comparability with commercial statistics of other countries, with our own census returns, and with the usual bookkeeping year of business houses. It is intended to simplify the returns by eliminating some distinctions deemed meaningless or even confusing to the public.

"Commerce Reports."

Through the cooperation of the State Department and the Government Printing Office, it was possible at the beginning of January, 1915, to expedite the issue of the daily publication of the Bureau of Foreign and Domestic Commerce so that a dispatch or cablegram from a consul or a field agent of this Department is printed and mailed to subscribers within twelve hours after the report is received at Washington. Within this period the dispatch, if received from a consul, is examined at the State Department, edited in the Bureau of Foreign and Domestic Commerce, printed, and put in the mail. To emphasize this change, and to identify our daily publication more completely

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with the whole work of the Department, the title was changed from "Daily Consular and Trade Reports" to "Commerce Reports." The business public has shown its appreciation of the increased value of the publication by a greatly increased number of subscriptions, with the result that the total amount of subscriptions paid exceeds the amount for any other publication of this Government.

Cost of Production.

The first full investigation conducted under the "cost of production" appropriation—that on the pottery industry—was completed and published during the last fiscal year. The report contained a careful analysis of all aspects of the industry in the United States, with a comparison of conditions in England, Germany, and Austria.

Similar studies were undertaken dealing with the general subject of clothing. Three of these reports—on women's muslin underwear, on hosiery, and on knit goods—were well advanced by the end of the fiscal year, and have since been completed. The field work was finished on the investigations of the cost of production of men's shirts and collars, and men's clothing, and reports on these subjects are now in course of preparation. Unfortunately the outbreak of the war prevented the extension of these investigations to European countries, so that a comparison of conditions here and abroad has been impracticable.

It is unfortunate that the wording of the appropriation confines this line of work to the cost of production. This is but one factor in determining our competitive ability as compared with foreign countries. The question of prices, proximity to the market and capacity of the market, the technical equipment of factories, and the cost of distributing the product when completed are all questions that merit careful investigation. Moreover, the term "cost of production" has come to have in the popular mind a political significance, since it has been used by a political party as a measure for tariff rates. These investigations should be divorced from any partisan bias and they should cover every important phase of industrial activity. To this end I recommend that the language of the appropriation act be broadened so as to permit a study of all phases of the industries under investigation. This valuable work calls for extensions both in the amount of the appropriation and in the lines of study authorized.

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Cost of Distribution.

We give much attention to railway freight rates, but we neglect a matter of far greater importance. The expense imposed upon consumers by the single item of cartage in distributing goods is certainly many times larger than the total cost of railway freights, possibly ten times as great. We know little about it, but the facts we do know are sufficient to show that we might well divert our thought from things deemed important which are relatively trifles, and look carefully into this serious matter. We know that the item of retail delivery costs more than all the transportation processes preceding it. We know that in phases of food distribution the necessary cost is multiplied eightfold or more by wasteful methods. It is certain that the cartage cost in half a dozen of our great cities runs up into hundreds of millions per annum, but few seem to think it worth while to study the matter. Inquiry into this subject might have far-reaching effects upon the cost of living, about which we talk so much while ignoring this very large element in it.

Appointments by Examination.

To make our field work as effective as possible, it is essential to select for each task the man best qualified to perform it. The selection of men is extremely difficult, since the salaries we can pay are modest, the term of employment in many cases is short, and our requirements extremely exacting. In the case of commercial agents and special agents, the man must be a specialist in the line on which he is to report, he must speak the language of the countries to which he is to be sent, and he must be a keen observer, able to report clearly the lessons that he learns.

Prior to last January selection was made in accordance with the statements of experience submitted by various candidates. The success of the examination system in the selection of commercial attachés made it seem desirable to use the same method in making appointments for other field service. After a voluminous correspondence, especially with commercial bodies concerned with the subject about to be investigated, a list of candidates is made up who are given a stringent written examination designed to test their qualifications. Those who pass most successfully the written examination administered by the Civil Service Commission are then invited to appear for oral examination before a committee of the officers of the Bureau and a representative of the Civil Service Commission. The results of the examinations already held have been eminently satisfactory.

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A large increase in the appropriation for this service is essential if the present standard of work is to be kept up; much more if its scope is to be extended to meet the demands of the business community. The work done speaks for itself. It returns manifold its cost to our commerce and industries. It is distinctly and directly productive. It is not an expense, but a profitable investment. Our country turns to the foreign field in commerce as never before in its history. Our finance, our industry, our agriculture, our merchandising, all are reaching out into lands abroad for the greater business they must have if American factories are to run full time with full product and if we are to maintain and extend the position which within the last year we have attained. There is a new spirit in American business—a spirit of outreach, a spirit of confidence in its own power, a desire for touch with the great markets of the world. The tide of our foreign trade runs strongly at its full and the wealth of the nations flows into our coffers. It is not long since we were a debtor nation. We have become a creditor. We confidently depend upon the wisdom of Congress, which has already supported this work, for the force and the funds with which to extend it.

For the administrative work at Washington a large increase is imperative. For years the field services of the Bureau have been extended and the demands of the American public for information have increased, with a decrease rather than an increase in the number of employees and the amount provided for statutory salaries. The field services to be effective must be carefully directed, and to this end it is imperative that considerable provision be made for the establishment of divisions under qualified chiefs to direct the activities of the commercial attachés, of the field agents abroad, and of the branch offices in this country.

The success of the commercial attachés during their first year demonstrates the need of increasing their number so as to cover many new centers of commercial importance. Even with the existing corps of attachés the appropriation is inadequate to permit the proper amount of travel and the Bureau has been compelled to limit the use of the cable to cases of extreme importance.

Larger sums are needed for field investigations both in Latin America and in other parts of the world. Much of the appropriation for promoting commerce has been needed for the establishment of branch offices. These must be strengthened to meet the increasing demands upon them as business houses come to appreciate more and more the valuable services that they furnish.

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The experiment of these branch offices has been an immense success, but if they are to do the work for which the communities in which they are located are daily calling they must be sustained on a proper scale. On account of the war it has been possible to minimize work in European countries, but with the conclusion of the war and the reestablishment of trade, without doubt along lines different from those formerly in existence, these markets should be carefully studied by specialists. For this opportunity we must be fully prepared.

With the return of peace we must not lose what we have gained in Latin America and elsewhere, but must be ready to meet the competition of European sellers.

Statistics of Domestic Commerce.

Heretofore we have studied almost exclusively foreign trade; it is time we turned our attention once more to domestic commerce. Some years ago statistics of internal commerce were collected in a fragmentary way, but with the lapse of the appropriation for this purpose the service had to be discontinued. It needs to be reestablished, not on the former scale, when only fragmentary information could be gathered, but on a scale commensurate with the importance of the subject and adequate to furnish the information needed. We are ignorant of many of the great movements of our own internal commerce, and because of that ignorance must leave undone much that would be helpful to it. We are proceeding concerning the great movements of our domestic trade by "rule of thumb," in the dark, and without knowing the precise facts. We do not know the relative importance of things which are but vaguely known to be important. It is an ignorance of which we should be ashamed and to which an end should be put.

For years preceding June, 1912, monthly statistics on internal commerce were published in a fragmentary way. On the date given, the appropriation was stopped. Protests were then made by business men, publishers, and others, but the service has never been restored. No publication, private or official, shows the movement of vessels and commodities on the Great Lakes or on the rivers and canals of the country. The principal coal movements by rail and water are not published, nor are the grain, live-stock, and cotton movements. There never were satisfactory data concerning the coastwise commerce, and there are none now. Yet this coastwise commerce is of great extent and is developing.

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The opening of the Panama Canal and the agitation for an inland waterway along the Atlantic coast make it important that we should know what we are about as regards our coastwise commerce. It is a surprising thing that we should require by law careful knowledge concerning our export trade and allow our domestic commerce to go on without any definite knowledge concerning it. This is caring for the cents and forgetting the dollars. It is looking after the little and neglecting the large. Congress will be asked for an appropriation sufficient to permit the beginning of an effort to throw light upon a subject of such vast importance but of which we know so little.

The extraordinary economic conditions resulting from the great European war have opened wide the door of opportunity in foreign trade to American manufacturers. Many of the latter have for the first time realized the importance of this trade and some have become interested and have begun to develop an export business who up to the time of the outbreak of the war had no thought of or interest in foreign markets. This widening interest has greatly added to the work of the Bureau of Foreign and Domestic Commerce. Its office staff, already overworked, has found it necessary to put in a steadily increasing amount of overtime to keep the current work up. It has, therefore, found little chance for expansion or for development of new promotive activities. It is especially important at this time that, with the tremendous opportunities in foreign trade now open to our country, the Bureau of Foreign and Domestic Commerce be provided with an adequate clerical staff, so as to cope with the equally increasing volume of work. The American manufacturer and merchant should have at his command service in promoting trade at least equal to that of our European competitors.

The time of opportunity is now and the door is wide open and entrance into it is more free than it has ever been before. The Bureau has accomplished large practical results in actually aiding American producers to get business and to sell goods abroad. This has reacted in the employment of labor. It is a fruitful work. It is a profitable work. It means much to-day for the American employer and the American workman and will mean much more to-morrow if the representatives of the employers and of the workmen and of the people whom these serve will give it facilities and funds equal to the opportunity which lies open for it.

For the details of the work of the Bureau attention is specially asked to the annual report of the Chief of the service, which gives

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a clear and interesting picture. It remains to renew my expression of appreciation of the invaluable assistance of the Consular Service in the work of our Department. The spirit of good will and of assistance which that service shows is wholly admirable. I desire to place on record my thanks to the Secretary of State and his associates in charge of the consular work. If there are any who may have thought that the work of the commercial attaché would in any degree conflict with that of our consular officers, they may put their fears at rest. Where services are animated by the spirit of mutual helpfulness, where each is glad for all the other can do of a common good and is more than willing to help in the common work, there is no room for small jealousies. We gladly acknowledge the debt of the American business world to the efficient and improving Consular Service and we are glad to have the privilege of cooperating with that service in bringing before the business world the results of their effective activities.

Commercial Attachés.

The work of the commercial attaché has so fully justified itself that there is urgent demand for its considerable extension. If there ever is a time at which that extension is urgently necessary, that time is to-day. A large portion of our possible foreign markets are entirely untouched by the commercial attaché service while other important markets are so combined as to receive inadequate service. There are no commercial attachés in Central America, India, the Near East, South Africa, or Canada. These are among the best possible markets for the goods of the United States. Spain, Portugal, and Italy receive but partial care through the commercial attaché stationed in Paris. Spain and Italy should each have a commercial attaché. The Spanish Government has been especially cordial to our commercial attaché to France when visiting Spain. The American Chamber of Commerce in Milan asked on May 18, 1915, that our Government appoint a commercial attaché for Italy, as will be seen from the following letter:

AMERICAN CHAMBER OF COMMERCE IN MILAN,
Milan, May 18, 1915.

SECRETARY OF COMMERCE,
Department of Commerce and Labor,
Washington, D. C.

DEAR SIR: At a regular meeting of the board of directors of the American Chamber of Commerce in Milan held on Monday the 17th instant it was decided to urge on the Government of Washington to appoint a commercial attaché for Italy.

He will find here a splendid field, as there was never a better opportunity than the present for America to get and hold its share of the business in Italy.

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Italy's sources of supply for much that she has used in the past have been closed, owing to the present political conditions, and her outlet for production of all kinds has also been closed in those countries, viz, Russia, Austria, Germany, and England.

The exports from the United States could be multiplied many times as could also the imports into United States from Italy if American business men could wake up to the fact that Italy is a great and growing country and by having a commercial representative attached to the embassy at Rome who could visit the different parts of Italy and study the needs as well as what these different parts of Italy can supply to America; he could with the cooperation of the American Chamber of Commerce give aid and advice which would have so much greater value because of his official position, and would thus greatly help the overwork of consular officials who have neither the time nor the training to obtain the information that this specialist will get.

Thanking you in advance for the interest which we are sure you will take in our request, we remain

Faithfully yours,

AMERICAN CHAMBER OF COMMERCE IN MILAN,
CHARLES F. HAUSS, *President*.

One should be appointed to the Scandinavian countries, another to Japan. Holland, and through her the immensely important Dutch colonial empire in the Far East, should also receive one. There should be a commercial attaché in India, in South Africa, in the Near East (which includes Egypt, Persia, Asia Minor, Greece, Roumania, and other Balkan States), in Central America, and in Venezuela and Colombia. It is therefore earnestly urged that Congress grant the request which will be made to establish the above ten additional commercial attachés.

It must be emphasized that the force of commercial attachés is a trained and picked force of men, selected for their peculiar qualifications for the work. They speak the language of the country to which they are assigned or a language current in commercial circles therein. They understand the principles and practice of export trade. They must meet on equal terms the best commercial minds of the countries to which they are assigned, representing therein the best and brightest in American commercial life. The post, therefore, of commercial attaché calls for exceptionally good men of special training.

Commercial Agents.

A number of investigations into special subjects have been conducted by the twelve commercial agents of the Bureau of Foreign and Domestic Commerce during the last fiscal year. Hardware received the attention which, in view of the magnitude of the industry and the opportunity for increasing our sales to foreign countries, it has long deserved. Mr. S. S. Brill traveled extensively in South America studying the special needs of the market, and collected samples of the kinds most in demand with full details of their cost, the character of competition to be met,

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and other information required by prospective exporters. From other countries similar detailed reports were asked from the commercial attachés, who were instructed to contract with hardware experts in each of the countries to which they were accredited to collect the information and the samples needed to open the way for the sale of American goods. The reports so obtained and the samples of these articles purchased by the attachés are fully expected to make one of the most complete studies of a foreign market for American goods ever undertaken by the Bureau. It is also intended to use the samples collected as a nucleus of a sample room to be established at the New York branch office of the Bureau.

The investigations of Mr. Ralph M. Odell into the markets for cotton goods were continued. Mr. Odell spent most of the last fiscal year in China, and, as a result of his study, has submitted a very full report on the market for cotton goods in that country. His work during the present year will be conducted chiefly in India. The investigation of the foreign market for lumber and lumber products was continued, Mr. Franklin H. Smith visiting for this purpose Hawaii, the Philippines, China, Siam, the Straits Settlements, and Australia, and Mr. R. E. Simmons covering the east coast of South America and Chile. Mr. Benjamin Joachim investigated the market for wearing apparel in Central America, and Mr. Garrard Harris studied general trade conditions there. Other investigations by special agents of the Bureau were confined to South America; Mr. L. L. Bucklew reporting on furniture, Mr. J. A. Massel on machines and machine tools, Mr. W. H. Lough on finances and credits, Mr. H. N. Douthitt on electrical appliances in Brazil, and Mr. E. H. Gueydan on transportation in Colombia and Venezuela.

In addition to the reports from our own officers a number of special investigations have been made by consuls at the request of the Bureau of Foreign and Domestic Commerce. Such special investigations are now carefully planned from the beginning and a schedule of the topics to be covered is included in the instruction sheet. The reports made by the consuls are consequently much more uniform and thorough than was formerly the case, and this result has been obtained without increased labor on the part of the consuls, since their attention is directed to those points on which American manufacturers need enlightenment. During the last fiscal year a comprehensive report was published on the paper and stationery trade of the world. Shorter reports treated of the

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markets for soap and cooking fats in South America, the iron and steel industry in Europe, tobacco trade of the world, foreign markets for coal, and the South American market for jewelry and silverware. An exhaustive handbook on India was compiled in the Bureau from various consular reports supplemented by much information collected from all available sources.

In the past, investigations by commercial agents were confined chiefly to foreign countries. Last year it was determined to broaden the scope of this work by authorizing similar investigations in the United States. A comprehensive study has been made of the water terminals and facilities at the various ports, chiefly by Mr. Grosvenor M. Jones. An investigation which has aroused wide popular interest is that of the dyestuff situation in the United States, conducted by Dr. Thomas H. Norton. One of the first serious effects of the war was the cutting off of our supply of artificial colors previously imported from Germany, on which our textile industry and other industries were vitally dependent. By direction of Senate resolution of January 26, 1915, the situation was thoroughly investigated and made clear to the public. A number of manufacturers have entered the field and the Bureau has done much to guide lines of manufacturing so as to answer the most pressing needs of the consumer. Aside from its published reports, it has conducted a large correspondence giving advice both to prospective manufacturers and to users of dyestuffs. It is not too much to say that the work of this service has been at the very center of the growing movement toward the creation of an American dyestuff industry. In this connection signs are not lacking that the growth of our native industry is hardly welcome to those who have heretofore had a substantial monopoly in supplying our markets from abroad. Our consumers, however, have had a bitter taste of what it means to depend upon a single source of supply, and that source one which has interests of its own of so much greater importance to it that the care for them necessarily cuts off the supply of the material we need. We are the greatest producers of the raw material for the manufacture of dyestuffs. We are, if not the greatest, at least one of the greatest, consumers of the finished product. It is intolerable that we should longer depend upon any one foreign source for these necessities of industry and it is equally intolerable that we should permit any possible unfair foreign competition to destroy a growing industry upon which so much depends by methods that would not be permitted by our law if used by our own citizens.

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BUREAU OF CORPORATIONS.

By operation of law the Bureau of Corporations was merged into the Federal Trade Commission upon the organization of the latter on the 16th day of March, 1915.

In the last annual report of this Department the impending separation of the Bureau of Corporations was referred to, and, in addition to describing the work done during the fiscal year reported on, a statement was made regarding the progress of work subsequent thereto down to the date of the report, November 10, 1914. The connection of the Bureau with this Department continued, however, for about four months thereafter, and in order to formally complete the record with respect to the activities of the Bureau of Corporations it will be sufficient in the present report to refer very briefly to the general activities of the Bureau of Corporations during the fiscal year 1915 and to the reports issued by it during that year.

The fact that the Bureau of Corporations was merged into the Federal Trade Commission necessarily affected the character of the work done by the Bureau during the fiscal year 1915. In addition to the regular work which was pending, much additional work was done in the gathering of information which would be valuable and immediately useful for the Federal Trade Commission upon its organization. Along this line were extensive investigations into the laws of "unfair competition" in foreign countries; the preparation of a card index of directors of the principal industrial and banking corporations of the nation; and the assembling of a large number of corporation reports obtained from the large corporations engaged in interstate commerce. During the fiscal year 1915, up to the 16th of March of that year, the following reports were issued by the Commissioner of Corporations:

Lumber Industry, Part II—Concentration of Timber Ownership in Important Selected Regions; dated July 13, 1914.

Lumber Industry, Part III—Land Holdings of Large Timber Owners; dated July 13, 1914.

Taxation of Corporations, Part V—Mountain and Pacific States; dated September 8, 1914.

Annual Report for the Fiscal Year 1914; dated October 8, 1914.

Conditions in the Healdton Oil Field; dated March 15, 1915.

Tobacco Industry, Part III—Prices, Costs, and Profits; dated March 15, 1915.

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Farm Machinery Trade Associations; dated March 15, 1915.
State Laws Concerning Foreign Corporations; dated March 15, 1915.
Trust Laws and Unfair Competition; dated March 15, 1915.

The Bureau of Corporations, which had been an important agency of the Department of Commerce from its establishment, in 1903, was thus severed from it after 12 years of conspicuous activity. During this period of its connection with the Department of Commerce under the direction of James R. Garfield, Herbert Knox Smith, Luther Conant, jr., and Joseph E. Davies, the several Commissioners of Corporations, it achieved marked success in the performance of the duties imposed upon it by law, namely, the impartial and thorough investigation of facts regarding certain business organizations and methods of competition. Extensive investigations and careful reports were prepared upon many matters, and among them the following: Beef Industry; Transportation of Petroleum; Report on the Petroleum Industry (in two parts); Report on Cotton Exchanges (in five parts); Report on Tobacco Industry (in three parts); Report on the Taxation of Corporations (in six parts); Report on Transportation by Water in the United States (in four parts); Report on the Steel Industry (in three parts); Report on the Lumber Industry (in four parts); Special Report on Present and Past Conditions in the Lumber and Shingle Industry in the State of Washington; Report on Cotton Tare; Report on Water-Power Development in the United States (in three parts); Report on the International Harvester Co.; Report on Conditions in the Healdton Oil Field; Report on Farm Machinery Trade Associations; Report on State Laws Concerning Foreign Corporations; Report on Trust Laws and Unfair Competition.

Extraordinary powers of investigation were conferred upon the Secretary of Commerce and the Commissioner of Corporations in connection with this work, and the exercise of these powers demanded tact and discretion.

Reports of this Bureau have enjoyed high reputation among scholars and experts, and undoubtedly had important influence in the development of governmental policy toward business and in the development of Federal legislation pertaining thereto.

The work of the Bureau of Corporations was antecedent and preliminary to the work now intrusted to the Federal Trade Commission, and the powers of the latter are the logical development of the functions of the Bureau of Corporations, which is now absorbed in its activities.

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BUREAU OF STANDARDS.

The Bureau of Standards serves as a testing bureau for the Government, but it is a great deal more than that. It is a national physical laboratory, including such branches of chemistry and engineering as are necessary to accomplish standardization in the broad modern sense. This means that it is not only engaged both in testing and research for all the departments of the Government but that its work is of vital interest to our industries, our commerce, and the entire field of development of scientific investigation.

Standardization not only enters into the familiar fields of commerce and trade, but it directly affects industrial processes, engineering practice, and many forms of legislation. The Bureau of Standards does the scientific and technical work requisite to develop and make useful to everyone standards of measurement, standard values of physical and technical constants, standards of quality, and standards of mechanical performance. To these are now added certain standards of practice where uniformity is needed in scientific and technical matters involved in the enactment of laws, regulations, technical codes, and the like.

The Bureau works in close harmony with the great technical and engineering societies of the country and with the practical engineers who in many lines of applied science are doing the work of the world. It is an intensely practical service, bearing directly and daily upon the life of our people. At one end of its work is research into things as yet unknown. At the other end is the putting of things discovered and determined at the service of our people. It studies in cooperation with the technical staff of our great railways the problems that underlie our transportation systems. In cooperation with the staffs of the Army and Navy it studies the problems of the wireless telegraph. It deals with the principles involved in aviation, with the character and behavior of structural materials and their resistance to fire, weather, and wear, with the accurate testing of instruments and the development of new ones for improved methods of testing and research. It reaches into the home by publications showing how accurate knowledge is helpful in domestic life. It

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studies the problems of chemistry and electricity, and operates a varied mechanical plant, working out the problems that vex the industrial manager.

It investigates the scientific principles beneath public-utility services and places at the disposal of the public and their official representatives that same accurate knowledge of public utilities which is furnished to the operating companies by their own technical staff. It works out the principles and practice of refrigeration, and operates testing cars that run about the land saying whether track scales tell the truth. It tests textiles and rubber and paper and numerous other materials. It studies how columns of different kinds behave under stress, and gives close care to the accurate timing of watches. It deals with bridge construction and with the members of wireless towers. It investigates standards of color, and tests photographic lenses. It studies illumination, and determines the accuracy of weights and measures. It does much more of the same general character.

It covers a site of 16 acres and occupies four laboratories 200 feet in length by 55 to 60 feet in width, four stories high. A fifth laboratory (the chemical laboratory) has been authorized, and on September 13, 1915, a contract was entered into for its construction at a cost of $188,556. Future plans include two more large laboratories. Four smaller buildings for special work have been constructed, and a large water-current meter testing tank is just about completed.

The Bureau operates a mechanical plant at Pittsburgh, Pa., in temporary quarters in the old arsenal grounds, through the courtesy of the War Department. It has long conducted a cement-testing plant in the cement district at Northampton, Pa.

Standards of measurement are those which concretely define units of measure. They underlie every indication of quantity or dimension. On such standards rests the application of scientific data to industry.

Standard values of physical and technical constants are those measured data determined with accuracy which control industrial processes. Every engineer has handbooks giving him data which he uses in his daily work, whatever it may be. The effectiveness of that work, and therefore of his service, is often in direct proportion to the correctness of the data he uses. The determination of such standard data is an important function of the Bureau of Standards.

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Standards of quality are modern in the scientific sense. Such a standard may take the form of a sample of a material found suitable for a given purpose. It is preferably, however, a description of the properties of the required material in terms of measurable quantities which both the maker and the user can understand and apply. In the latter form they are known as technical specifications. In proportion as these are given in units of weight and measure describing the properties which insure the desired quality the specification becomes a standard of quality. To determine such standards demands the widest range of experience in testing and using materials and the most careful experimental study of the underlying scientific principles. This important function of the Bureau of Standards is rapidly gaining public appreciation.

Standards of mechanical performance are specifications, in measurable terms, as to the performance of a device or machine. These standards are perhaps the most complicated of all, since they involve standards of measurement, standard values of constants, and standards of quality. In this field of standardizing mechanical performance the Bureau's work has been confined largely to assistance given Government services in the design and specification of equipment, but the necessity for this work in connection with the Government alone has far outgrown the Bureau's facilities.

Standards of practice are involved when enacting laws in which technical and scientific matters are concerned, in ordinances regulating public utilities, and in establishing building and safety codes. Like standards of performance, they are dependent also upon both standards of measurement and standards of quality, and bear directly on the welfare and safety of the public. The citizen depends upon these standards, though he may not know it, when he rides in a trolley car, lights the gas or electricity in his house, or uses a gas range in his kitchen.

It may be truly said of the Bureau of Standards that its field is the scientific world, and this can be interpreted as widely as the needs of man. In this broad field the Bureau can of course touch only upon the more important aspects of the work where an authoritative value or national uniformity is required. It does not enter fields which can be covered effectively by private laboratories. It cooperates with such. It does not seek either to replace or to compete with them.

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Weights and Measures.

The Bureau of Standards has continued the work of stimulating a nation-wide interest in the weights and measures of daily trade. Without a systematic inspection service through the country for trade measures, the honest dealer is at a disadvantage and the consumer helpless, since the standards involved are in the custody of the Government. The Bureau accomplishes this purpose largely through State and local inspectors, by comparing their standards with those of the Government, by instructing them as to apparatus, methods of inspection, and tolerances, and by aiding in the preparation of laws and ordinances. It also aids manufacturers of weighing and measuring devices by comparing their standards with those of the Government and by furnishing them with the essential principles involved in the construction of such apparatus. In many cases the public standards are compared directly with those of the Bureau; as, for example, the standards used by the industries in the regulation of their weighing and measuring devices. This service to the public is not limited to assuring the length of the yard, the weight of the pound, or the capacity of the gallon. It includes all factors affecting the correctness of measurements. The Bureau makes a theoretical study of the sources of error in measuring devices, suggests methods of measurement, methods of testing instruments, tolerances, standard containers, and other matters entering into an efficient weights and measures inspection service.

The Tenth Annual Conference on Weights and Measures was held on May 25–28, 1915. There were present 28 delegates representing 18 States, the District of Columbia, and the Philippine Islands, and 69 city and county weights and measures officials; also 80 visitors representing railroads, manufacturers of weighing and measuring apparatus, trade bodies, etc.

The Bureau exerts a far-reaching effect on the standards of fair dealing in trade. It is the recognized center of such matters, where one interested in weights and measures may come for assistance, and where all are assured of a fair hearing in case of disagreement. Manufacturers of measuring instruments come for suggestions as to improving their products and State and city officials visit the Bureau to examine its equipment and methods. State legislators and officials request the Bureau's judgment in technical details of inspection service, and the Bureau's opinion is sought by Congress upon matters pertaining to weights and measures legislation.

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The Bureau cooperates with the Treasury and Agricultural Departments in the enforcement of the law requiring the quantity contained to be marked on package goods. The enactment of this law was the result of the movement toward correct weights and measures which has been going on throughout the country since the establishment of the Bureau. This law gives the consumer a direct knowledge of the net quantity of the product in most of the packages he buys. The Bureau's experts assist the board designated by law in the technical details of specification and measurement of quantity.

The large number of tests made for State governments and the requests for information from them indicate the growing interest in weights and measures inspection. The purchase by several States of additional standards also shows the expansion of State work.

During the past year there has been a very decided movement on the part of the Government bureaus toward the inspection and regulation of weighing and measuring devices used in purchasing supplies. This has included the specification and testing by the Bureau of the scales used in the Postal Service, customhouses, navy yards, Government institutions, and reservations. The importance of this work can only be realized by one familiar with the enormous amount of supplies purchased by the Government and the wide variation in the quality of all measuring devices. At no time in the Bureau's history has it rendered this service to such an extent as during the past year.

The testing car equipped for testing railroad track scales, which was purchased in 1913, has been in continuous service throughout the fiscal year except for one month while under repair. Through it the master scale of the State of Minnesota was standardized in July, 1914. Since then there have been tested 338 railroad track scales in the States of Minnesota, Wisconsin, Indiana, Iowa, Missouri, West Virginia, Virginia, North Carolina, South Carolina, Georgia, Florida, and Alabama, and in the District of Columbia. Seventy-eight other scales were tested in the navy yards at Norfolk, Va., Charleston, S. C., Key West, Fla., and Pensacola, Fla. Large scales were tested in 86 different cities and towns. Railroads owned 241 of the scales tested, manufacturing concerns owned 89, and the Federal Government owned 8. Two-thirds of the track scales failed to pass the tolerance (200 pounds in 100,000) adopted by the Bureau. The possible error in weighing

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a 100,000-pound car was found to vary from 30 pounds to 21,600 pounds.

Reports on the condition of these scales were rendered to the organized departments of weights and measures of the respective States and to the owners of the scales. Advice relative to the proper maintenance and repair of the scales was a part of the report. Appreciative replies to these reports have been received, and usually repairs or new installations have followed.

Improved methods are being devised for testing, adjusting, and determining the capacity of track scales, and the Bureau is preparing standard specifications for railroad track scales which will be valuable to all concerned.

In the above work 21 States have been visited since October, 1913. A second track-scale testing car has been put in operation for the further development of this important service and this is now at work in New England.

Precision Standards of Measurement.

The necessity for precision standards of measurement of length, mass, capacity, heat, light, electricity, and magnetism, in connection with scientific work, is generally appreciated. The problem of preparing and maintaining the precision standards needed by the Bureau in its own work is one which requires the most difficult researches in the field of physics and chemistry. In many cases cooperation with the national laboratories of other nations is necessary in order to secure international agreement in these fundamental standards of measurement. In all cases the Bureau aims to steadily improve the precision standards and the methods of maintaining or using them. It is not true, as is commonly supposed, that the need for precision standards of measurement arises only in connection with accurate scientific work. The requirements of the industries in this respect are often quite as exacting, sometimes more so. The Bureau assists the industrial development of the country by aiding the introduction of exact scientific methods of measurement to an extent which is appreciated by few others than those directly concerned.

Relation of Bureau's Work to Manufacturing.

In addition to the ordinary units of measurement, almost every industry has special units and methods of measurement, together with a variety of measuring instruments. The Bureau studies these with a view to their improvement. It certifies the stand-

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ards by which such instruments are constructed and compared. It is frequently necessary to examine the conditions under which measuring instruments are used, to aid the manufacturer to secure accurate measuring instruments, and to apply precise methods of measurement. The Bureau is aiding the industries in this and other ways of basic importance. Modern industrial processes are often efficient in direct proportion to the precision of the methods of measurement used.

The relation of all forms of the Bureau's work to our industries has greatly increased in importance during the year. Manufacturers are coming to understand the value of applied science to them. The day of rule of thumb is passing away and accurate knowledge—that is to say, applied science—is taking its place. There are some still so ignorant as to talk about what they call "practical methods" as compared with scientific ones; but this is after all often another way of saying that they prefer not to know what they are about. A method is not less practical because it is scientific. If it is not scientific—that is, if it is done without knowledge of why it is done—it is very likely not to be practical. One of the great services the Bureau of Standards daily renders to the country is that of helping our industries to be more scientific; that is to say, to know their business better. Other countries have understood this better than we and have built up whole industries, which we have lacked, because they applied science to their processes. Unless we do this ourselves, we shall not hold a high place in the industrial race.

During the last year manufacturers have been compelled to introduce new methods, to use new materials, to develop new processes for making products formerly imported. The Bureau has striven to be of every possible use to manufacturers in this difficult period of transition, and many have taken advantage of its services.

The engineering professions have appealed to the Bureau more than ever before for facts concerning the properties of materials and for fundamental scientific data. The representatives of the organized scientific societies and technical associations of manufacturers render the Bureau valuable assistance by contributing information gained in practice and by pointing out the data which they most need. As examples, may be cited the series of commercial steel columns which have long been under test in our large Emery testing machine to develop the fundamental laws of such columns. In this work the American Society of Civil Engineers

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and the American Railway Engineering Association cooperate. Both have given the Bureau valuable advice.

The determination of the fundamental constants needed by refrigerating engineers is nearing completion and constitutes one of the most difficult pieces of work undertaken by a physical laboratory. Many other illustrations of this sort can be given.

Manufacturers are intensely interested in the Bureau's work in the investigation of structural materials. It was first undertaken for the Government to secure information needed in its own structural work. This information is, however, precisely what the manufacturer of such materials needs to know, and its value to the public in this way is far greater than that through the Government service.

Manufacturers and the public likewise are interested in the Bureau's study of the fire-resisting properties of materials. Too little is known of materials of construction in this respect. The public anxiously awaits data upon which may be based reasonable codes and regulations looking toward the prevention of the enormous annual losses due to fire.

The Bureau has in progress several important investigations for the cement industry to determine the properties upon which the value of this important material depends.

Manufacturers of clay products increasingly demand information about the properties of the materials they use. They seek such knowledge also of their manufactured product, whether it be pottery, terra cotta, building brick, tile, fire brick, fire-clay crucibles and retorts, or enameled iron ware. In few industries is there greater opportunity for improvement by the application of precise methods of measurement and of scientific knowledge. These industries are making rapid strides in the applications of science, and have been compelled to meet many new conditions during the past year. An item has again been included in the annual estimates providing for the continued study of this important line of industry.

During the year the production of chemical porcelain on a commercial basis has begun in this country. The clay products division of the Bureau of Standards, located at Pittsburgh, Pa., having worked the subject out fully, presented the results of their labors to manufacturers, and two concerns are now producing chemical porcelain ware of satisfactory quality. The same division of the service is working with success on the problem of producing optical glass of the best quality. Neither

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chemical porcelain nor optical glass of the best grade has heretofore been made in this country.

These are but examples of the intimate contact of the Bureau's work with industry. They show in part how its work is vital to industrial development. Similar examples from almost every industry could be given.

Another important service of the Bureau is the stimulus which it continually gives to the establishment of industrial research laboratories. Since the establishment of the Bureau this has become a distinct industrial movement in the country. Many large manufacturing plants now have well-equipped laboratories for scientific research. These utilize the work of the Bureau and are enabled to carry on investigations which would otherwise be impossible. These laboratories are notably increasing the applications of science to industry. The Bureau has shown the need for technical research by calling attention to unsettled problems, and in pointing out the values of specific researches by actual instances of service rendered.

Educational Institutions and the Bureau of Standards.

The scientific laboratories of the higher institutions of learning are engaged in investigational work in every branch of science. In all of these researches, especially in physics and chemistry, precision standards are needed. Before the establishment of the Bureau an investigator was frequently required to spend more time in the preparation of the standards of measurement used than in the main work at hand. During the year the Bureau has performed services of this character for practically every university in the country and especially for the State universities. These institutions are in constant correspondence with the Bureau in reference to the standards, methods of measurement, values of physical constants, and the properties of materials, the latter especially in connection with technical education. The Bureau publications are found in the reference libraries of the universities and technical schools; in many its publications are used in connection with the instructional work.

This service to educational institutions is highly appreciated by them. The American Physical Society, composed of instructors and investigators in physics, holds annual meetings at the Bureau that its members may become familiar with its work. Similar meetings are held by other scientific societies. It has become the custom in many technical schools for the

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senior classes in science and engineering to visit manufacturing plants and other laboratories during vacation, and the Bureau of Standards is generally included in the itinerary.

The Bureau cooperates with educational institutions in planning and carrying out scientific investigations in those matters which pertain to the Bureau's various fields of activity.

The Bureau of Standards as a Government Testing Bureau.

The various branches of the Government service have availed themselves of the facilities offered by the Bureau for testing until approximately 90 per cent of the Bureau's testing is for the Government service. This large proportion is due to the fact that the commercial testing of materials to ascertain whether or not they comply with specification is done only for the Government, except in unusual cases, where the public is not provided with suitable facilities. The actual testing for the public is confined largely to standards of measurement. The Bureau has thus become a testing laboratory for the Government, performing more than a hundred thousand tests during the year for its various bureaus and independent establishments. It serves them in questions pertaining to units, standards, measuring instruments, methods of testing material, and in the planning of devices and apparatus when the Bureau is especially fitted by equipment, facilities, and personnel to render expert assistance. It tests many thousand samples of materials delivered under contracts, to ascertain whether they conform to the quality standards specified. This work is carried on in such manner that the experience gained may be utilized in drafting improved specifications—that is, in the development of standards of quality—and it has contributed largely toward placing Government purchases on a scientific and businesslike basis.

The Bureau has made many special studies of the properties of the more important structural materials, as well as paints, oils, varnishes, textiles, paper, rubber, inks, and other miscellaneous materials, with a view to securing the information needed in the improvement of Government specifications. Many of these materials are now purchased under definite specifications and the supplies delivered tested. The importance of chemical tests in this connection has increasingly engaged the attention of the Bureau. It has conducted many chemical tests in connection with the specification of purchases of Government supplies. By supplementing these chemical tests with physical tests, it is fre-

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quently found possible to select material which would best meet the service conditions and specify them in terms of susceptible measurement. Both the manufacturer and Government gain by the use of a definite specification of the properties of the materials desired. This is possible to a far greater extent than is realized. The useful character of the service being rendered by the Bureau in the testing of materials used in Government construction is evident when it is remembered that by this systematic testing efficiency and safety are guaranteed as fully as the present state of the arts will allow. The many rejections of unfit material are a partial index to the defective construction that might have been accepted without such testing. Furthermore, there is a growing conviction on the part of those experienced in such testing that it should be performed by an agency which is connected with neither the buyer nor the seller. This work leads to the adoption of standard specifications for materials for all purposes, and the results which can be given to the public are perhaps of even greater value to it than to the Government service.

Publications and Information of the Bureau of Standards.

The Bureau of Standards renders an important service in publishing information on subjects within its scope. During the year thousands of letters were received requesting information of the most varied character as to standards, methods of measurement, and properties of materials. These requests came from a wide range of sources, including Government bureaus, State institutions, public-service corporations and commissions, industrial laboratories and plants, commercial houses engaged in foreign trade, consulting engineers, educational institutions, and the general public. The replies ranged from a brief answer to a carefully prepared report, depending on the importance of the question involved and the service to be rendered. In a large majority of the inquiries the replies were in the form of one of the Bureau's publications. These are issued in three series: The Scientific Papers, of which 254 have been issued, contain the results of the Bureau's scientific investigations; the papers of Technologic Series, of which 49 have appeared, contain the results of investigations pertaining to technological subjects; and a series of "Circulars," of which 55 have been issued, each of which contains the information the Bureau desires to give on a particular subject. When the Bureau receives a considerable number of inquiries regarding a subject, one of these circulars is prepared on that sub-

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ject, including the best information that can be obtained from any source. These are revised from time to time as new material is developed. They become the standard reply to many requests for information on the same subject but from widely different sources.

The Bureau can often suggest means of securing approved data for many industrial processes; in other cases it prevents costly experiments and minimizes the chance of failure, especially where standards of measurement are involved. The latest methods of measurement wherever developed are usually known or available to the Bureau, which thus serves as a clearing house for technical information as to materials, units, standards, instruments, and methods of measurement. While the Bureau is without police power to enforce its decisions, it has exerted a widespread influence by virtue of its unbiased attitude and its care to arrive at accurate results. The success with which the Bureau is making its results available to the public through correspondence, consultation, and publications is recognized by national technical societies, through which the Bureau is exerting an important influence in current technical practice.

Extravagant claims are often made by inventors and promoters leading to unwise investment on the part of those with limited means. The Bureau renders frequent service, sometimes in connection with the Postal Service, in indicating the fraudulent character of such claims. Often large amounts of money have been wasted on impossible schemes. The Bureau tries to convince such inventors or investors of the hopelessness of their attempt. In such cases the Bureau merely measures the performance claimed and exposes the facts. On the other hand, the Bureau is constantly assisting intelligent inventors where advice is sought upon matters properly within its functions.

The Bureau's Work in Connection with Public Utilities.

Another important and growing field of the Bureau's work has to do with the standards of measurement, of quality, and of practice concerned in the various public utilities, particularly electric light and power, gas, street railway, and telephone service. This work includes scientific and engineering research in connection with public-utility questions, the preparation of specifications regarding the quality of service, the methods of testing and inspection employed by municipalities and commissions, safety rules for use by the utility companies in safeguarding their em-

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ployees and the public, and the collection and distribution of information regarding these subjects.

Regulations for gas service as made by city officials or State commissions include among other things requirements as to meter accuracy, the testing of meters, specifications as to the heat value or candlepower of the gas or both, the degree of chemical purity, the variations in pressure that may be allowed, and the frequency of tests necessary to determine whether the operating companies conform to their requirements. The Bureau made a thorough study of these questions relating to gas service, and prepared a circular on the subject which has reached its third edition. This publication has served a useful purpose as a basis for regulations which are fair both to the public and to the utility companies. It also contains model ordinances for the use of cities which control their own utilities, and rules suitable for adoption by State commissions which fix standards of service.

Another circular issued during the year gives a detailed technical discussion of the methods of gas testing. The Bureau has also been studying the questions pertaining to the specification of the electric light and power service, and the requirements that should be made by city or State commissions to govern such service. Model ordinances have been prepared to suit the various conditions met with in cities and communities of different size. A set of rules suitable for adoption by city commissions has been prepared and a digest of the requirements now in force by the various commissions. It must not be assumed that these model laws and ordinances cover in detail all of the facts involved. They are confined simply to the scientific and technical data involved which should be everywhere uniform and consistent with scientific principles.

Many important investigations have been carried on by the Bureau in the past and are now in progress for the purpose of securing the proper scientific data upon which to base such laws and regulations. This knowledge was not to be had until developed by the Bureau. As an illustration may be mentioned a study which has been in progress at the Bureau for some time as to the conditions which result in the destruction of underground pipes and metal work by stray electric currents. The Bureau has studied this question for five years and has done a large amount of work in connection with it. This has included laboratory investigations concerning the effect of electric currents on concrete and metal pipes, tests of pipe coverings, corrosion of metal

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in the soils, methods of measuring soil conductivity, and other experimental phases. The results of this investigation are now being utilized in many cities to mitigate electrolysis.

A study of the protection of buildings against lightning has been in progress for the past year. A publication on the subject will soon be issued. This includes a discussion of methods of lightning protection, results of experience as shown in vital statistics, and records of fire insurance companies, and other useful information. The Bureau has also been engaged in a study of life hazards in electrical practice and in the preparation of a national electrical safety code, also a national gas safety code along the same general lines. In the preparation of these codes the Bureau is receiving the cordial support and cooperation of the interests involved.

The Bureau aims to serve as a clearing house for information on the scientific and technical questions arising in connection with the regulation of such utilities. In some States there are no public-service commissions to issue regulations or inspect the quality and safety of the service rendered by the various utility companies. In others these commissions have taken little or no action in such matters, although having authority to do so. In either case, cities and towns must look after their own interests and have frequently taken the matter up with enterprise and understanding, and the Bureau has been able to render them valuable assistance in the way of scientific and technical advice.

The need for standards of practice is most apparent in connection with the regulation of public utilities and the establishment of safety codes. The studies made by the Bureau of Standards have been directed toward simplifying this problem by providing well-defined specifications as to what constitutes good service. The resources of the Bureau, however, are not sufficient to enable it to do all of even the most necessary work; some of the most important steps have not yet been taken up. It will obviously never be practicable for any State commission or city to handle these questions independently, though they possess a large building and engineering stations and employ specialists for each separate problem.

From the standpoint of uniformity, economy, and efficiency, it is desirable for the Federal Government to do a certain portion of this work. Therefore, the Bureau of Standards has been assisting in it as far as possible within the limits of its functions and its facilities. The success and approval with which the work has been met thus far adequately justifies its expansion.

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Recommendations as to Buildings, Equipment, Personnel, and Special Investigations.

As in previous reports, attention is called to the necessity of properly housing the structural-material work, especially that branch of it temporarily located in buildings of the War Department at Pittsburgh. These buildings are entirely unsuited for the purpose either as to character or location. The Bureau has considered it unwise to expend any funds on their preparation as laboratories other than for the barest necessities. Furthermore, the War Department has repeatedly asked for the vacation of the building.

Although the Bureau is striving to place its structural-material work on the basis which its importance warrants, the funds available are barely sufficient to meet the needs of such testing as the Government itself alone requires. Considerable heavy equipment has, however, been accumulated both at Pittsburgh and Washington and more will be needed to make the plant complete. If this work is to be done as it ought to be, in view of the fact that every citizen is more or less directly interested in it, it is necessary that the large testing machines, furnaces, and other heavy apparatus should be assembled in a building designed for the purpose and of sufficient size to permit doing the work effectively.

There is greatly needed a large transverse testing machine capable of testing full-size plate girders, arches, floor constructions, and similar work. Our accurate knowledge of the laws governing the behavior of girders used in construction stops when we reach a moderate size. Beyond that point our knowledge is as yet imperfect. We do not certainly know what we are about. There is quite too much of guesswork and too little of determined fact. We ought not to wait for some accident to so disclose the limits of our knowledge that we shall, under the pressure of such circumstances, take the step which should be taken now.

I quote from my last report the words of the late Alfred Noble, one of America's most distinguished engineers:

> The use of steel and concrete in girders in the construction of bridges and buildings is increasing rapidly. The calculations of strength of such girders are to a large extent based on theory, not well checked by actual tests; such tests as have been made were on small girders, and the value of the results in determining the dimensions of large girders, such as are now in common use, is doubtful. It is questionable whether, on the one hand, many structures in daily use are not perilously near the breaking point; or, on the other hand, whether the structures are not built unnecessarily massive and costly.

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There is therefore great need of a large testing machine for actually testing the strength of girders of large size. Such a machine, operated under the direction of the Bureau of Standards, would soon repay its cost by inducing more economical and safer construction.

The recent opening of Van Ness Street north of the Bureau at a place not adjoining the Bureau's grounds makes it desirable to secure a small strip of land between that street and the Bureau's grounds on the north. It is also desirable to secure the narrow strip between the Bureau and Tilden Street on the south.

For the past three years the scientific and technical staff of the Bureau has not been increased except through the provisions of a few special funds. In the meantime its work has increased several fold and to such an extent that the Bureau is seriously handicapped in the performance of its duties. It is earnestly recommended that the scientific staff be increased in order to meet urgent existing conditions.

A special fund is also recommended for the purpose of determining the values of the more important physical constants. This fund need not be large, but should extend through a series of years sufficiently long to enable the Bureau to accomplish permanent results. Such data are exceedingly difficult to produce and involve much specially designed apparatus as well as the services of trained physicists and chemists who can devote their time exclusively and continuously to the work.

The testing of textiles by the Bureau of Standards for the year just closed included 33,000 separate routine tests and over 300 cooperative tests. About one-tenth of these were for the Government departments. Many special investigations have been undertaken; for example, on the effect of cotton compression in baling upon the spinning qualities of the fiber. Bales now run about 25 pounds per cubic foot. If cotton can be further compressed without injury to the fiber, savings could be effected in bale covers, transportation, warehouse charges, etc. Compression tests up to a density of 50 pounds per cubic foot will be made.

The Bureau has also investigated the subject of the cotton bunting which is now manufactured for making flags as a substitute for the more expensive wool bunting. Numerous laboratory tests were made which included strength, weight, and fastness of color to light, water, and chemical reagents. This cotton bunting was also subjected to actual service, or practical weather tests on the seacoast. In every instance where the cotton was

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tested a wool sample was similarly treated, thus enabling a comparable examination of the two fabrics after treatment to be made. As a result of this investigation large quantities of cotton bunting are now used in the Navy and other departments.

The textile work of the Bureau includes the development of specifications for textiles; the testing of samples submitted by bidders as a basis for award of Government contracts for supplies; the testing of delivery on contract to check the compliance with specifications; the development of standard methods of testing; and miscellaneous research involving experimental work, physical measurements, and testing.

The Bureau's overtime record of the minor clerks and assistants ($1,200 and below), who have stated duties and work on schedule, shows 3,569 hours' overtime, or 510 days (based on clerical working day). The record of the men above $1,200, who give the greater part of the overtime service, is no longer kept. The last data show for the staff in the Washington laboratory 1,112 hours for one month. In general the staff has shown a fine marked readiness to meet exigencies. Overtime is willingly given, especially by those in the more responsible positions.

There is urgent need in the Bureau of Standards for an assistant to the Director, for an editorial clerk, and for a property clerk. The time of the Director is hampered with details of administration which prevent his giving to the large problems of the service the time and the attention that they need. The publications are growing in number and in importance, and it is impossible for them longer to be properly supervised as an incident in the work of busy men employed on other important matters.

A very large amount of valuable property exists in the group of buildings occupied by the Bureau for which the present organization does not provide a proper custodian. The request for a property clerk has been made before, but the matter has become one of such importance that it is renewed with special emphasis in the belief that the interests of the Government and the safekeeping of its property require that this additional subordinate be supplied.

In concluding that portion of my report which deals with this great scientific service, it is proper to speak of the relation between the scientific staff of the Government and its naval and military staffs, and of the relation of the scientific staffs in our great universities to both, as respects pay, certitude of employment,

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time allowed for vacation or study, opportunity for promotion, allowances, and other elements that affect employment.

The naval and military staffs of the Government are educated at a great public cost, are assured of permanent employment and of retirement upon a basis that assures protection in their old age. The scientific staff of the Government is no less productive. It is constantly consulted by the officers of the naval and military forces, and a cordial spirit of earnest cooperation exists between them. The man of science, however, whose research may provide the wireless telegraph or make possible the construction and operation of a great ship, who solves the problems of light and heat, develops explosives, and draws from out the recesses of nature the facts that all men utilize—the man of science, I repeat, pays for his own education, has no certitude of employment, and can look forward to no protection in his old age.

If the man of science desires the economic security which his work should provide, he must look outside of the Government for it. Though he serve the Government ever so faithfully, it does not extend to him the hand of helpfulness that the military or the naval officer receives.

Our young scientific men after leaving college start their professional work in our laboratories at $1,000 or $1,200 per annum, which makes an interesting comparison with the compensation awarded, for example, at the Naval Academy, plus a free education. If a young scientific man secures a sufficient standing in his science to enter our service at $1,600, it is usually because he has at his own cost spent several years longer in a university in order to earn the degree of Doctor of Science. In a service like the Coast and Geodetic Survey, the men must devote the best years of their lives to working in all parts of the United States, Alaska, and the Philippines; must go to sea in small crafts and at the risk of storms and unknown dangers survey waters which through their own efforts are being charted for the first time. They must give up the home life which every man desires, and must endure hardships and dangers at least equal to that which any military service requires. It is not just that men of equal education and equal productiveness, assuming similar risks in the service of their country, should receive unequal treatment. The result of the present condition is that we are frequently losing able and trained men whose places can only be filled by those who are inexperienced, who in turn graduate into broader and safer fields of activity. The

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practical attitude of the nation toward the men of productive science seems to be the very reverse of that which it holds to the trained officer of soldiers or sailors.

No comparison is drawn even in thought between these various groups of useful, unselfish public servants. There is no thought of exalting one above another. The comparison is between the way in which the Government treats one and the other and between the way the scientific man is welcomed in our industries and in our universities. He is not so warmly welcomed in the Government service, which needs him so much and which he serves so faithfully.

The men of science in the Government employ do much if not most of the basic work on which our economic structure, our transportation systems, and our industrial processes depend. They do not receive a commensurate reward.

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BUREAU OF THE CENSUS.

The work of this important service was under the care of Hon. William J. Harris, of Georgia, until March 15, 1915. At that time he resigned pursuant to his appointment as a member of the Federal Trade Commission. His successor, Hon. Sam. L. Rogers, of North Carolina, was appointed Director of the Census March 16, 1915, and the work of the service has from that time been continuously in Mr. Rogers's care.

During the fiscal year this Bureau completed its decennial inquiry relating to wealth, debt, and taxation; issued its decennial reports on insane and feeble-minded, paupers, and Indians in the United States; published a decennial bulletin on Negroes in the United States and carried on the compilation of a detailed report on the same subject; completed and issued its decennial Statistical Atlas; completed its quinquennial census of electrical industries; conducted and brought well toward completion its quinquennial canvass of manufacturing industries; carried on its regular annual investigations relating to mortality, municipalities, and cotton and cottonseed; made its semiannual collections and publications of tobacco statistics; undertook a new line of work, the collection of financial statistics of States; took two special censuses of municipalities; and complied with numerous requests for information contained in its records.

PROGRESS OF ROUTINE WORK.

Census of Manufactures.

The largest single task of the past fiscal year was the quinquennial census of manufactures, taken as of December 31, 1914. After many months of preliminary organization a force of more than 1,300 special agents was assembled during December, 1914, to collect the statistics of manufactures throughout the United States. The preliminary work included the preparation of many schedules and of lists, as nearly complete as possible, of names and addresses of manufacturers throughout the country. The lack of an appropriation for the purchase of city directories from which to obtain this information caused some inconvenience and delay. Arrangements were made, however, to borrow directories

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from mayors and other officials of some of the cities and to obtain them for other cities from the Library of Congress. This facilitated the work and resulted in a material saving.

An earnest attempt was made in the preparation for this important census to cooperate with chambers of commerce, boards of trade, and associations of manufacturers. Valuable suggestions were received from many bodies of this kind, both local and national. The Director and the Chief Statistician for Manufactures visited many important cities to confer with bodies of business men, and the schedules, when prepared, represented the combined thought of business bodies as well as that of the service itself.

The schedules were mailed to all manufacturers, and a large number were filled and transmitted by them through the mail to the Bureau ready for use. In this way over 50,000 schedules were received without any expense for field work in collecting them. As a result of this I had the pleasure of requesting the Committee on Appropriations of the Senate to reduce by $40,000 the appropriation which had at that time passed the House of Representatives and was pending before the Senate committee. This reduction was accordingly made pursuant to my request.

In point of rapidity and accuracy, the record for this census of manufactures promises to be more satisfactory than that of any preceding one. Both the field and office work are much further advanced than at the corresponding date for the preceding similar census. Already a large number of press summaries have been issued giving statistics for individual cities.

The lack of suitable office accommodations arising from the congestion in the Commerce Building because of the assignment required by law of a considerable space to the Federal Trade Commission has been a serious obstacle to the successful conduct of the manufactures work. The force of the Manufactures Division had at times to be assigned to work in rooms used for storage purposes, thus removing them from proper administrative control and preventing them from working to the best advantage. This condition was not remedied until large numbers of the force left for the field work.

As the report of the Director shows, the work of the Census Bureau requires more room. It is earnestly desired, therefore, that the request of the Federal Trade Commission for its own quarters be granted in order that we may avail ourselves of the space now occupied by it. Failing this, the question will arise either of stopping or delaying a long time the work of the Census

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or of providing additional quarters for some of its work. The Census service was moved to the Commerce Building at a great saving to the Government, but it was never contemplated when this was done that by law there would be quartered in the building, against the protest of the Department, an additional service then not existing. This latter service, the Federal Trade Commission, joined with the Department in urging that it be provided quarters elsewhere. The request being refused, embarrassment all around has existed ever since and will exist until a change is made.

Electrical Industries.

The compilation of the quinquennial census of electrical industries, relating to the year 1912, which covered central electric light and power stations, street and electric railways, telephones, telegraphs, and municipal electric fire-alarm and police-patrol signaling systems, was completed early in August, 1914. The detail work in connection with the printing of the reports consumed so much time that they were not issued until April, 1915. Two volumes were published, the first relating to central electric light and power stations and street and electric railways, and the second to the remaining subjects named.

Wealth, Debt, and Taxation.

The decennial investigation of wealth, debt, and taxation was completed during the fiscal year. The results were published in the form of eight separate bulletins and an abstract. After the issuance of the entire series of bulletins, their contents were bound together in two volumes having a total of 1,642 pages. The final copy was sent to the printer on March 15, 1915—less than a year and a half from the beginning of the office work and about a year from the commencement of the field canvass. This establishes a record for rapidity of work.

Financial Statistics of Cities.

The preparation of Bulletin 126, presenting these statistics for the fiscal year 1913, was completed July 30, 1914, and the bulletin was issued in the following September.

The field work on the current investigation under this head, which relates to the latest fiscal period terminating prior to July 1, 1915, was begun early in 1915 and is being rapidly completed. It is purposed to have the results of this inquiry in the hands of the printer by December 15 or January 1, which will be nearly a year earlier than most similar reports have heretofore been sent to the printer.

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General Statistics of Cities.

This investigation covers form of government, police departments, water-supply systems, and liquor licenses and taxes, as fully detailed in the report of the Director of the Census. Prior to and including 1909 general statistics of cities had been collected biennially, but this inquiry was not made in 1911 and 1913. The present inquiry relates to the fiscal year 1915 and is carried on in connection with the collection of financial statistics of cities, embracing the same municipalities and made by the same force.

Cotton and Cottonseed.

During the year the Census Bureau gathered and published statistics relating to cotton ginned, consumed, imported, exported, and on hand, and active spindles, and to cottonseed and linters. Notwithstanding the unusual difficulties attending the movement of the crop of 1914, there was no delay in the collection and publication of the data. All of the reports were published on dates corresponding with those on which they were published in preceding years.

Special attention is called to the consumption of linters for the manufacture of explosives. There is no definite provision of law for the collection of statistics in regard to linters, but the Bureau has acted on the theory that linters form a part of the cotton crop, and the data concerning them are collected in connection with statistics relating to the quantity of cotton ginned.

The Bureau of the Census also gathers statistics respecting the quantity of cottonseed crushed, but this is done incidentally to collecting data concerning cotton ginned. No direct provision of law requires an inquiry into cottonseed and cottonseed products.

It would assist the Bureau in carrying on this work if there was a provision of law requiring the Director of the Census to collect statistics of the quantity of cottonseed crushed and linters obtained and of the distribution of linters.

Tobacco.

Under authority of an act of Congress approved April 30, 1912, the Bureau makes semiannual collections and publications of statistics of stocks of leaf tobacco held by manufacturers and dealers. The reports for the fiscal year 1915 related to October 1, 1914, and April 1, 1915, and were issued November 9, 1914, and May 5, 1915, respectively.

Three other Federal bureaus—namely, the Bureau of Internal Revenue of the Treasury Department, the Bureau of Crop Esti-

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mates of the Department of Agriculture, and the Bureau of Foreign and Domestic Commerce of the Department of Commerce—also collect and publish statistics relating to tobacco. In order to avoid the duplication necessarily resulting from this state of affairs, to systematize the work, and to make it possible to publish an authoritative report concerning the production, consumption, and stocks of tobacco, an interdepartmental committee was appointed to consider the entire subject. The report of this committee included a recommendation for the repeal of the act of April 30, 1912, which recommendation has the approval of this Department. The Bureau of Internal Revenue is arranging to collect statistics quarterly concerning the stocks of tobacco carried by all dealers and manufacturers. These will be more reliable than the data collected by the Bureau of the Census, which relate only to stocks carried by certain classes of manufacturers and dealers. There is no necessity for duplicating this work, and the facts gathered by the Bureau of Internal Revenue will serve every public purpose well.

The full report of the committee is given in the annual report of the Director of the Census.

Vital Statistics.

The annual report, Mortality Statistics, 1913, and the Index of Joint Causes of Death were completed and published during the fiscal year. The work on the report for 1914 is progressing satisfactorily, and it is expected that this report will be ready for the printer soon after January 1, 1916.

Life, or Mortality, Tables.

These tables, which show the expectation of life for various elements of the population of certain States, are being compiled under the supervision of Prof. James W. Glover, of the University of Michigan. It is expected that they will be ready for the printer by February 1, 1916.

Dependent, Defective, and Delinquent Classes.

During the fiscal year the Bureau issued reports on the insane and feeble-minded, and on paupers in almshouses, and since the close of the year a bulletin relating to the blind population of the United States has been issued. The complete report on the blind, and also one on the deaf and dumb, are in preparation. Work is also being done on the investigation relating to prisoners and juvenile delinquents. A bulletin on this subject was pub-

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lished prior to the beginning of the fiscal year, but the full report has not yet been issued. These publications, which are issued decennially, are based in part on data obtained at the last census of population and in part on statistics gathered by correspondence.

A summary of State laws relating to dependent, defective, and delinquent classes was prepared during the first half of the fiscal year and was issued in December, 1914.

Negroes in the United States, 1910.

A bulletin with this title has been issued, and work is proceeding on a detailed report on the same subject. This will show the growth of the Negro population from 1790 to 1910, inclusive, and its geographical distribution, migration, dispersion and segregation, marriage and divorce, fecundity, intermixture with whites, mortality, educational progress, occupations, agricultural conditions, economic progress, religious affiliations, criminality, insanity, and pauperism.

Indians in the United States, 1910.

The work on this report, which is based largely on data contained on the special Indian schedule used at the Thirteenth Census, was discontinued in February, 1912, because of the large reduction in the temporary Thirteenth Census force, and little more was done on the report until the close of April, 1914. A bulletin embodying the results of the work already done, however, was issued in June, 1913. The last section of the report was released for printing in October, 1914. There was considerable delay, however, on account of the limited force of clerks available for this work, in getting the checking and proof reading done. The report was finally issued on July 3, 1915.

This report covers 12 subjects, namely, population, stock and tribe, blood, sex, age, marital condition, school attendance, illiteracy, inability to speak English, occupations, fecundity and vitality, and Indians taxed and not taxed.

Occupations.

An Index to Occupations, alphabetical and classified, has been prepared for the official use of the Census Bureau and other Federal offices as well as for the use of State bureaus and of associations, societies, institutions, etc., which may desire to classify occupations in conformity with the classification employed by the Bureau of the Census. It shows in alphabetical order the

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more than nine thousand occupational designations given in the Thirteenth Census report on occupations and classifies these designations into the 428 occupations and occupational groups listed in that report.

Work was done in preparation of supplementary occupation statistics, showing certain details not brought out in the general report on occupations. This work, however, was suspended early in October, 1914, in order to advance the work on the census of manufactures, and has not since been resumed.

Statistical Atlas, 1914.

The compilation of this publication was completed before the close of the calendar year 1914, and the atlas was issued in January, 1915. This volume, which is published decennially, presents a great number of maps, charts, and diagrams showing in graphic manner the more important results of the various census inquiries.

Official Register of the United States.

The compilation of the Official Register of the United States is progressing satisfactorily, and it is expected that this publication will be ready for distribution in December, 1915.

NEW WORK UNDERTAKEN DURING THE YEAR AND SINCE ITS CLOSE.

Financial Statistics of States.

The collection of financial statistics of States, similar in scope to the financial statistics of cities which are annually gathered by the Bureau, was authorized by me on June 20, 1915, and the work was immediately begun. The data obtained in this investigation will cover for each State its latest fiscal period terminating prior to July 1, 1915, and it is purposed to have them ready for distribution in January, 1916. Legislation will be necessary to provide for the subsequent annual collection of this information.

Censuses of Tulsa, Okla., and Hamtramck, Mich.

A special census of Tulsa, Okla., was taken in April, 1915, at local request and expense, upon direction of the President. This census established a precedent in that it was the first Federal enumeration of the population of a city, separately from that of the State in which it is located, ever made between decennial census years. A similar census of Hamtramck, Mich., was taken in June, 1915.

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Monograph on Cancer.

A statistical monograph on cancer, relating to the calendar year 1914, is being compiled and will probably be ready for the printer by the close of the present calendar year. In addition to showing the number of deaths from cancer throughout the registration area and in each of its subdivisions, this monograph will present information of a more detailed character than that given in the Bureau's annual report on mortality.

Directory of Institutions.

The Census Bureau is preparing for publication a statistical directory of State institutions for the care or custody of defective, dependent, and delinquent classes.

PLANS FOR FUTURE WORK.

Marriage and Divorce.

The first Federal investigation of marriage and divorce as a distinct subject was made by the Department of Labor and covered the 20 years from 1867 to 1886, inclusive. The next was made 20 years later by the Bureau of the Census and covered the period from 1887 to 1906, inclusive. Each of these investigations was specifically authorized by Congress, but no provision was made for future inquiries relating to this highly important subject. No argument is needed to demonstrate the desirability of making this inquiry at regular intervals. Legislation is therefore recommended authorizing the decennial collection of statistics of marriage and divorce, beginning in 1917.

Decennial Census of Water Transportation.

It will be necessary during the latter part of the fiscal year ending June 30, 1916, to prepare schedules and organize a field force for the decennial census of water transportation, which will relate to the calendar year 1916.

Monograph on Tuberculosis.

A statistical monograph on tuberculosis relating to the calendar year 1915 will be prepared. This monograph, like that for cancer, will show, in addition to the number of deaths from tuberculosis in the registration area and in each of its subdivisions, various detailed statistics not given in the regular report on mortality.

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Religious Bodies.

The next decennial census of religious bodies will relate to the calendar year 1916. Some preliminary work on this investigation has already been done, and further preparations will be made as rapidly as possible.

Child Labor.

The Bureau expects, if the pressure of other work is not too great, to issue a bulletin on child labor, based on the occupation statistics of the Thirteenth Census.

Supplementary Studies of Occupation Statistics.

It is hoped to supplement, as opportunity offers, the occupation statistics heretofore published in Volume IV of the Thirteenth Census Reports. The Bureau is receiving many inquiries for a further development of these occupational facts, and they not only will have value in themselves but will furnish a basis for comparison with the occupation statistics derived from the census of 1900 and with those which will be obtained at future censuses. Details are given in the report of the Director of the Census.

Forest Products.

The annual collection of statistics of forest products should be authorized. Such statistics were collected by the Census Bureau in cooperation with the Forest Service of the Department of Agriculture for the years 1907 to 1912, inclusive. The work was discontinued by reason of the absence of any specific provision of law authorizing it. The statistics for 1914 have been collected in connection with the quinquennial census of manufactures, but in the absence of legislation it will be impossible to collect them for 1915 or any subsequent year in which a census of manufactures is not taken.

These statistics are very useful and are in great demand. The Forest Service of the Department of Agriculture has requested that the annual work be renewed, and has recommended legislation to that effect.

Children Born and Living.

An important special tabulation which the Bureau of the Census is planning to make in the near future will show, for various race and nativity classes and age groups, for urban and rural localities, etc., the number of children borne by women enumerated at the last census, and the number still living on the census date.

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LEGISLATION NEEDED.

Legislation should be enacted providing for the annual collection of statistics of forest products, of cottonseed and cottonseed products, and of State finance, and the decennial collection of statistics of marriage and divorce. The desirability of this legislation has already been set forth.

The changes in the scope of the Official Register which are recommended in the annual report of the Director of the Census should be authorized by law.

The requirement of the decennial collection of statistics relating to the business of express companies, now contained in the act of June 7, 1906, should be repealed. Annual statistics of this character are collected and published by the Interstate Commerce Commission, and the decennial conduct of a similar investigation by the Census Bureau is unnecessary.

The act of April 30, 1912, requiring the Bureau of the Census to make semiannual collection and publication of statistics of stocks of leaf tobacco held by manufacturers and dealers should be repealed, as hereinbefore explained.

Express, rather than implied, authority should be given the Director of the Census to furnish transcripts of tables and other records and to prepare special statistical compilations for State officers and private individuals, and the provision should be so drawn as to make the amounts received for work thus done for outside parties actually serviceable to the Bureau, instead of only nominally so as at present. The authority under which the Bureau now performs this work is found in section 32 of the Thirteenth Census act.

OFFICE FORCE.

The appropriation act for the fiscal year 1915 provided for 589 permanent officials and employees of the Census Bureau. The number provided by the act for 1916, under which the Bureau is now operating, is 569.

The Census Bureau is seriously handicapped in carrying on its work, not only by reason of the inadequacy of its force at times, as during a quinquennial census of manufactures, but also because of its exceedingly low average salary scale. The percentage of the Bureau's force receiving more than $1,200 per annum as provided for by the current appropriation act is only 14.8. This percentage is a trifle more than three-fifths as high as for the other bureaus and offices of the Department of Commerce taken

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as a group and is much lower than that for any other individual bureau or office of the Department. It is also much lower than the corresponding percentage in nearly all bureaus and offices in the other executive departments. This state of affairs results in the loss to the Bureau of many of its most valuable employees, who are able to obtain higher salaries elsewhere, both in and outside the Government service.

The service lost in the last fiscal year 34 clerks by transfer to other offices, and 1 official and 15 clerks by resignation.

It is impossible to lay too great stress on the unfortunate results of this indefensible state of affairs. On the one hand, the Bureau has lost a considerable number of its most valuable and efficient employees—men and women whose places can not be adequately filled by the simple process of promotion or appointment—and has thus become, to that extent, a training school for other bureaus with more liberal salary scales. On the other hand, the employees who remain are, in many cases, drawing far less pay than is given for comparable service in other bureaus in this and other departments. From the standpoint of the employees this is unjust, and from the standpoint of the Bureau it is a disadvantage in that it naturally tends to engender a spirit of discontent and indifference.

It can not be too plainly stated that the conditions imposed by law upon the Census service are such as to prevent its operating with the effectiveness the Director earnestly desires. The facts are fully stated in the report of the Director of the Census, who fully coincides with his predecessor in this important matter, and whose report has my approval.

In the hope of remedying this state of affairs, it is the intention of the Bureau to present for consideration by Congress a plan for the readjustment of salaries in the present salary classes of $1,800, $1,600, etc., so as to increase the number of high salaries and reduce the number in the $1,200 class, which is now proportionally too large. This plan can be put in force without any increase in the appropriation.

It should be noted here that the Bureau's statutory force for the fiscal year 1916 is but 569, whereas 10 years ago (1906) it was 691, or 122 more than the present number. A portion of this reduction (32 employees) is due to the removal of the Census Bureau to the Department of Commerce Building and the consolidation of a part of its force with that of the Department. Apart from this, however, the service is operating with 90 fewer

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employees than it had 10 years ago. Then, as now, the Bureau was taking a census of manufactures. Since 1906, however, two new lines of work have been given the service, viz, the biennial compilation of the Official Register and the semiannual publication of tobacco statistics. Furthermore, every other element of work is much greater than 10 years ago by reason of the growth of the country in that time. It is the fact, therefore, that the Bureau of the Census is doing more work to-day with a smaller force than it did 10 years ago, and this force is working under conditions which do not permit its highest efficiency. For these conditions neither the Bureau of the Census nor the Department of Commerce is responsible. They are the result of law. That law should be changed. The Census Bureau has been able by improved methods and mechanism to neutralize in part the above-named disadvantages. Its difficulties are nevertheless grave and their seriousness increases.

EQUIPMENT.

At the present time the Bureau does not possess a sufficient number of typewriter tabulating machines or adding and calculating machines to meet the requirements of the manufactures work. Its supply of desks, chairs, and filing cases is inadequate; in fact, in only one division is the equipment of this character sufficient to meet properly the needs of the daily work. Twenty-five additional automatic tabulating machines will be required, and the sorting machines must be thoroughly overhauled. The automatic punching machines must be both overhauled and remodeled.

A new-model tabulator head has been constructed in the machine shop which has advantages over former models. It has been in use for several months in tabulating mortality statistics and has operated well.

It is necessary now to look forward to the taking of the Fourteenth Census in 1920 if that work is to be done in the most effective and economical manner. There has been in the past just public criticism of some of the delays in publishing the results of the Census work; but the fact must not be overlooked that a great part of the results is printed and distributed in bulletin form many months, or even a year or two, before the bound volumes constituting the final reports are issued. However, the furnishing of even a part of those results to the people several years after their immediate usefulness has passed can hardly be commended as good practice.

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This, however, is hindsight, and foresight is what is now needed. Such foresight has in this case its normal bearing in connection with the machine shop and machine equipment of the Census service. There follows a statement showing the cost of tabulating machines and of machine-shop operation and equipment from July 1, 1905, to June 30, 1916, in comparison with the cost of doing the mechanical tabulating work of a single decennial census through an outside contractor.

Cost of tabulating the Twelfth Census (1900) on rental basis (Hollerith Co.)			$462,799.24
Cost of equipping and operating mechanical laboratory and of machines made therein during 11-year period 1905–1916:			
July 1, 1905, to June 30, 1906 (tabulating statistics)	$9,068.87		
July 1, 1906, to June 30, 1907	29,000.00		
July 1, 1907, to June 30, 1908 (appropriation)	30,000.00		
July 1, 1908, to June 30, 1909	29,849.89		
July 1, 1905, to June 30, 1909		$97,918.76	
Thirteenth Census (1910) period (July 1, 1909, to June 30, 1912):			
Salaries for machine shop	118,254.63		
Tabulating machines and parts	60,361.67		
Punching machines and parts	80,286.12		
Machine-shop supplies, tools, etc	39,142.73		
Expenditures during Thirteenth Census period		298,045.15	
Expenditures to June 30, 1912			395,963.91
July 1, 1912, to June 30, 1913		26,595.12	
July 1, 1913, to June 30, 1914		26,570.92	
July 1, 1914, to June 30, 1915		11,876.58	
July 1, 1915, to June 30, 1916 (appropriation)		12,000.00	
July 1, 1912, to June 30, 1916			77,042.62
Total expenditures			473,006.53

It will be noted that the mechanical laboratory cost from July 1, 1905 (its beginning), to the end of the Thirteenth Census period, $395,963.91. This represents tabulating 430,000,000 cards and sorting 745,000,000 cards. If these had been tabulated and sorted under the arrangement existing prior to the installation of the Bureau's own machines, the tabulating at 65 cents per thousand would have cost $279,500, and the sorting at 20 cents per thousand, $149,000, or a total of $428,500, compared with an expenditure of $395,963.91, which represents the total maintenance of the mechanical laboratory. If the office could have

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had cards tabulated for 50 cents per thousand and sorted for 15 cents per thousand, as it attempted to do, the cost would have been $326,750. Assuming that the Bureau could have entered into an arrangement splitting the difference between the price asked by the contractor and what the office wished to pay, the cost of tabulating during the Thirteenth Census would have been $377,625. To this sum should be added, for the purpose of comparison, tabulating work done during the 11 years from 1905 to 1916, principally in the Division of Vital Statistics, which would have amounted to $6,000 or $8,000 per annum on a rental basis. Allowing $66,000 as the minimum total cost of this work, the total expense of tabulating the Thirteenth Census and of doing the vital statistics and miscellaneous tabulating work of the Bureau, on the basis of the arrangement referred to, would have been $443,625. This amount is comparable with $473,006.53, the cost of the mechanical laboratory during the 11-year period. The latter figure exceeds the former by $29,381.53, an amount which represents less than half the value of the machine-shop equipment and tabulating machinery owned by the Bureau. It is obvious, therefore, that the Government has saved largely by making its own machines.

This excellent result can be bettered if the mechanical laboratory is provided now with the funds it needs to prepare the new machines for the work of the Fourteenth Census so that they shall be completed and ready for use when that work begins. This work is of a kind which can not be hurried. It can not be made the subject of a rush appropriation at the last minute. If that is done, there will be serious loss of money and danger of confusion of work. What is spent now in careful preparation of the mechanical apparatus needed will be returned many-fold.

I have therefore included in the estimates $30,000 as the first of four annual allotments requisite to bring the work of the mechanical laboratory up so that the mechanical equipment of the service shall be ready when the stress of the Fourteenth Census work falls upon it.

Reference is made to the appendixes of the report of the Director of the Census for details as to publications issued during the fiscal year, for the report of the interdepartmental committee on tobacco statistics, heretofore mentioned, for details of the proposed change in the distribution of appropriations for salaries, and for a statement showing the nature and distribution of

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the office and field forces of the service on September 30, 1915. The following is a summary of the Census force on that date:

Officials	17	Special agents (general force)	22
Clerical	534	Special agents (temporary force)	141
Subclerical	20		
Machine shop	6	Total	740

Special agents to collect statistics of cotton 749

The Director's report also contains a statement of the appropriations and expenditures for the fiscal year 1915.

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BUREAU OF FISHERIES.

The Deputy Commissioner of Fisheries, Dr. E. Lester Jones, resigned April 14, 1915, to accept the appointment of Superintendent of the Coast and Geodetic Survey on April 15, 1915. Dr. Henry F. Moore, who has been since July 7, 1896, actively connected with the Fisheries Service, was promoted to the post of Deputy Commissioner of Fisheries to succeed Dr. Jones.

The old building in which the Fisheries Service is housed has lasted one year more and changes have been made on the lower floor which provide more office room, an enlarged tank for the live seals, and give a much more attractive appearance to the venerable structure. It is, however, wholly unfit for its purpose and of more value as a historical relic than anything else. Almost 60 years ago it was an armory. After 20 years it became a storehouse. Four years later it was used as a fish hatchery. The manager of an industrial plant who permitted it to continue in the service to which it is put would probably be discharged for incompetency. I renew the recommendation made earlier in this report that the administrative portion of the Fisheries Service be combined with the rest of the Department in a new Government building, and that a suitable working aquarium be provided for the study and development of the important food supply the Fisheries Service has under its care.

Propagation of Food Fishes.

Although the fiscal year 1914 was in general the most successful in the history of fish culture in the Federal Government, the year ended June 30, 1915, excelled it in every respect—the number of fish produced and distributed was much larger, the quality was better, the cost per million was less. The cost of fish produced and planted was $403 per million in 1894, $287 per million in 1904, $136 per million in 1914, and but $131.55 per million in 1915.

During the past fiscal year the Bureau conducted fish-cultural operations at 50 permanent hatcheries and 76 subhatcheries, auxiliaries, and egg-collecting stations. The regular hatcheries fall naturally into five categories, as follows: Atlantic rivers, for salmon, smelt, shad, striped bass, white perch, and yellow perch, 5; Pacific rivers, for salmon and steelhead trout, 12; Great Lakes,

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for whitefish, cisco, lake trout, and pike perch, 5; interior waters, for basses, sunfishes, crappies, and trouts, 25; and Atlantic coast, for cod, haddock, pollock, flounder, and lobster, 3.

The aggregate output during the fiscal year 1915 was 4,288,757,804 fry, fingerlings, yearlings, adults, and eggs, the last being transferred to the State fish commissions for incubation in local hatcheries. This output was about 241,000,000 in advance of the previous year, the increases being among the whitefish, cisco, chinook and dog salmons, lake and brook trouts, black basses and crappies, pike perch and yellow perch, cod, flounder, and lobster. Among the fishes of which there was a reduced output are the blueback and humpback salmons, shad, haddock, and pollock. Most noteworthy and most serious of the cases of diminished production is that of the shad in the Chesapeake basin, where the hatcheries were practically put out of commission because the fish could not reach their spawning grounds on account of impassable barriers of nets in Chesapeake Bay and at the mouths of the rivers. The shad-fishing industry of Maryland and Virginia is being steadily destroyed. It is hardly worth while longer to run the hatcheries at Havre de Grace (Susquehanna River) and Bryans Point (Potomac River).

Plants of food fishes were made in every State and Territory in rivers, large lakes, and other public waters, and in numerous small lakes, ponds, and streams. Most of the plants in minor waters were on farms. It has been demonstrated that an acre of water on a farm may be made equal to an acre of the best land for producing food, and the Fisheries Service is endeavoring to stock the minor ponds, natural or artificial, in order to distribute fish food as widely as practicable over the interior of the country. The Bureau stocks these small ponds with suitable food fishes without expense and instructs the farmer in their care. A manual of fish culture on farms is in preparation.

Fish and eggs were distributed to the fish commissions of 27 different States, a list of which with the allotment to each appears in the report of the Commissioner of Fisheries. Over 518,000,000 eggs, over 5,000,000 fry, and over 400,000 fingerlings and larger fish were thus distributed. Consignments of various fishes were also made to Porto Rico, Cuba, India (rainbow trout), and Japan (rainbow trout).

The distribution of the output required over 146,000 miles of travel by the five special cars of the Bureau and 491,000 miles by

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detached messengers. All transportation was paid for except 116,665 miles which was donated by certain railroads.

Under the act appropriating $20,000 for an additional fish-transporting car, a contract was made on April 29, 1915, for the construction of a new steel car of improved design. This is an adaptation of but an improvement over the wooden cars used for the past 25 years. The entire car, including all interior bulkheads, partitions, doors, berths, lockers, and water tanks, is of steel. It has a length of 60 feet ½ inch over ends of body plates, and a standard width of 10 feet. The weight of the car with equipment will be 150,000 pounds, and it is designed to carry a load of 35,000 pounds, including water, fuel, ice, and other supplies, making its total weight when loaded 185,000 pounds, or 92½ tons. The car is especially designed for carrying live fish long distances. In the center, running lengthwise on each side, is a line of insulated tanks with a capacity for 130 10-gallon cans in which to transport fish. These tanks will accommodate 10,000 to 15,000 fingerling bass, 65,000 trout of 2½ inches, 6,500,000 shad or whitefish fry, and 25,000,000 pike-perch fry. During transportation the fish will be furnished with oxygen and fresh water by means of air and water pumps, which will be operated by a 6-horsepower steam boiler which also furnishes heat to the car. In addition to this independent heating system, the usual train attachment for heating the car from the locomotive is provided for. Tanks for carrying a reserve water supply are located beneath the car, and an ice box to hold 1 ton of ice is installed. In addition to the facilities for the transportation of fish, the car will be fitted with living accommodations for a crew of five men, a cook's galley, an office, and space for a dining room. When completed this car will be detailed on the regular distribution work of the Bureau, which embraces every section of the United States excepting Alaska. This car will be finished and put into service during the winter of 1916. It is intended that this new car, the finest in the world for its purpose, shall in the course of its regular duties be open to public exhibition in the principal cities it may visit in order that all persons interested may have as full a chance as possible to see the nature of its work and the means for performing it.

The planting of the humpback salmon of the Pacific in the waters near the coast of Maine, which was mentioned as an experiment in my last report, has proven successful. Numbers of these fish have been taken during the summer of 1915 in the Maine rivers and eggs have been secured from them—the best possible

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proof of the success of acclimatization. The growth of these fish has been so rapid that some persons are skeptical about them, not understanding how a fish can come in two years to be 7½ pounds in weight. This species of salmon, however, was selected for that reason, and the laws of nature provide that it shall attain its full maturity, spawn, and die on or about its second birthday. It is the shortest lived of all the Pacific salmon, but not the less useful on that account. The Atlantic salmon in the Penobscot River, the only stream that has this fish in noteworthy numbers, seems to be holding its own under very adverse conditions.

Sufficient time has not elapsed to determine the extent to which the experiment in transferring Atlantic lobster to the coast of the Pacific Northwest has been successful. Another carload will shortly be sent forward and no facts have come to light throwing doubt upon the success of the matter.

More than once damage has been done by stocking waters with fish that are unsuitable for them. With the best of intentions demands have been made and strongly urged, the granting of which would mean the destruction of valuable native fish. Many fish are cannibals and the introduction of a swifter and stronger cannibal into a pond tenanted by other desirable fish can have but one result, the cannibal survives. It is the policy of the Service, therefore, to which strict adherence is given, that applications for fish for stocking purposes will not be granted when it is known that injury to other valuable native fishes will follow. To plant spiny-finned game fishes from eastern waters in salmon and trout waters of the Pacific States would simply mean destruction. The Fisheries Service is gratified by the approval given this policy by the fisheries authorities and commercial organizations of the Western States. It should be upheld by all who have regard for preserving the native food fishes in every part of the land.

The urgent needs of the fish-cultural service are as follows:

(*a*) The placing of the segregated field operations under district inspectors or field superintendents, so that frequent inspections of the hatcheries may be possible and increased economy and efficiency may result through closer coordination and cooperation. The experience in the Pacific coast district, where a field superintendent is provided, shows the desirability of extending this work to all parts of the country. It will result in larger food production at lower cost.

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(*b*) The substitution of all-steel fish-transportation cars for the remaining four wooden ones, which are worn out and obsolete. Modern traffic regulations demand steel cars. The old wooden cars are no longer safe and their use should be discontinued as rapidly as new ones can be built to replace them. Meanwhile the demand for the use of these cars is growing and the mileage traveled in distributing fish increased during the last year over 1,300 miles per month and averaged over 12,200 miles monthly.

(*c*) A stanch seagoing motor boat for each of the two remote salmon hatcheries in Alaska, where only small open boats are now available. These are required for the proper conduct of the existing fish-cultural work, for the transportation of supplies, and for the extension of operations into promising adjacent fields now beyond reach.

(*d*) The establishment of a lobster-rearing plant in connection with the marine fish-cultural operations. All authorities on the lobster agree that the results from lobsters reared to beyond the free-swimming stage are infinitely greater than those from lobster fry. The plant is not expensive, and the methods of rearing are now so well worked out that the Department is not justified in failing to take this important step.

(*e*) Authority to discontinue at least one station where the output does not justify the cost of maintenance and where, on account of a changed condition of the water supply, there is no probability of improving matters. It is not proposed to abandon hatchery work in any given State, but to relocate at some suitable place and dispose of the old property to the best advantage.

(*f*) The establishment of a limited number of new hatcheries in selected fields, especially in Alaska, where the Government is responsible for the welfare of the fishing industry.

The very extensive operations connected with the artificial propagation and distribution of food fishes are going far to maintain the supply, but in nearly every field there is need for increased output to meet the annually increasing consumption. This need is being met in part by greater efficiency in fish-cultural methods, by the occupation of new fields, and by small additions to the number of existing hatcheries; but it is evident to all who have given the subject thoughtful consideration that the situation, from the standpoint of the Federal Government, demands a further increase in fish-cultural work in various sections, as, for instance, the lower Mississippi Valley, the great southwestern region, and the Pacific coast.

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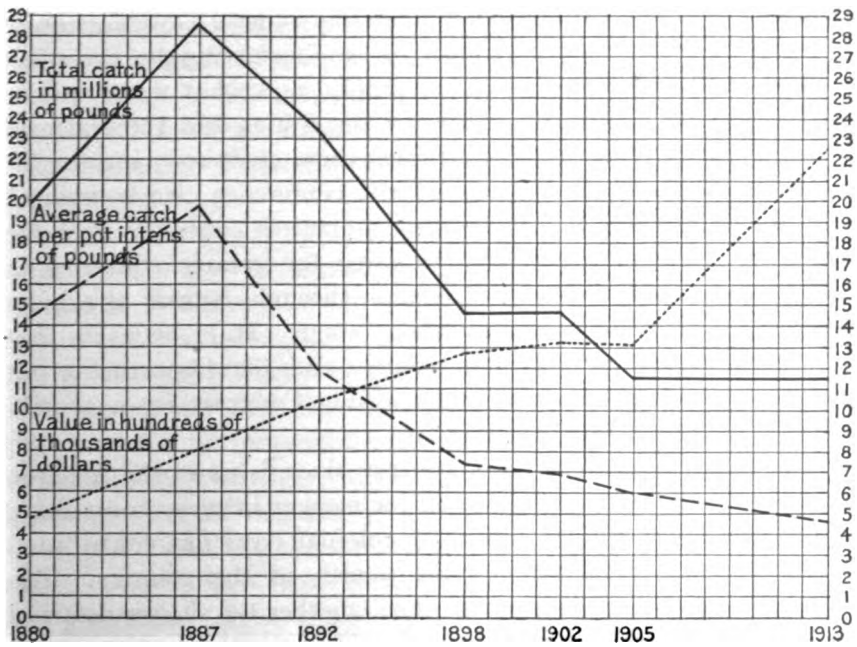
The Fishing Industry.

Many branches of the fishing industry of the United States are in a satisfactory condition and some of the more important are flourishing. Several branches are causing the Department much concern because of their downward trend and the apparent inability of the States to meet the situation.

Among the most valuable products of the Atlantic coast waters is the lobster, which supports an industry in all the States from Maine to Delaware. The supply in the regions of greatest abundance has steadily declined in recent years, and even the dimin-



ished catch has been made possible only by the use of larger quantities of apparatus and by the inducement for increased exertion on the part of fishermen afforded by inflated prices. In the 24 years ended in 1913, the United States lobster output decreased 60 per cent in quantity but increased 178 per cent in value to the fishermen. A graphic history of the lobster fishery for various years between 1880 and 1913 is shown in the diagram above.

The causes for this decline are well known and fully appreciated throughout the lobster-producing States. The conditions are what would naturally be expected from eight separate jurisdictions combined with inharmonious laws and with flagrant

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disregard for laws and for the welfare of the lobster industry among elements of the fishing and general coastwise population. Artificial propagation by Federal and State Governments has not been adequate to maintain the supply under these circumstances, and most radical action, forced and sustained by an awakened public sentiment, is now required.

A conference called by the Secretary of Commerce of officers having charge of the fisheries in the eight lobster-producing States, to consider the condition of the lobster fishery, met at Woods Hole, Mass., early in July, 1915. Its main object was to consider the relations of the Bureau of Fisheries to the lobster industry, the obligations resting on the Federal Government in connection with the maintenance of the lobster supply, the effect of varying State laws upon that supply, and what was requisite in the way of cooperation between the States and the National Government and between the States themselves to maintain the supply. Resolutions adopted by the conference clearly pointed out the path which the States must pursue in order to arrest the decline, and emphasized the necessity for greater efficiency in artificial propagation to be secured through rearing the baby lobsters beyond the free-swimming stage. It is believed that good will result from the conference, and the Department has shown its willingness to help by asking Congress for authority to establish a lobster-rearing plant.

The most valuable of the migratory river fishes of the Atlantic seaboard is the shad. It is taken for market in every coast State from Florida to Maine, and since colonial days has contributed largely to the food supply and wealth of the country. The question is now being seriously asked whether the shad is destined to go the way of the sturgeon. The Department has repeatedly sounded the note of alarm, and has pointed out the shortsighted and destructive course pursued by some of the States with reference to this most important fish. The most serious condition exists in the Chesapeake basin, where, in 1915, the fishery was the poorest ever known, following a season that was the poorest in a generation. The shad, coming in from the sea on its way to the spawning grounds in fresh water, receives no protection other than that afforded by the laws requiring certain channels or ranges to be kept open for the passage of vessels and boats. No limits are placed on the operations of the fishermen, who seem blinded to their own interests; every stream which the shad can try to ascend is literally choked with nets; and only a pitiable remnant

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of the schools that run in from the sea in spring reaches the spawning grounds. Shad hatcheries built, maintained, and operated by the Federal Government at great expense have practically been put out of commission by the inability to obtain eggs for hatching purposes, and a calamitous failure of the crop in the near future may be expected as a result of the present foolish policy or absence of policy. The livelihood of many is being needlessly destroyed and the food of more is being taken out of their mouths.

The Bureau made a comprehensive canvass of the shad fishery of Chesapeake Bay and tributaries in 1915, and now has data on which to base a final appeal for proper treatment of the shad. Failing to secure adequate legislation, the next step must be the abandonment of fish-cultural work in localities where it is not appreciated and the concentration of effort in communities where the maintenance of the fish supply is regarded as a serious function of the State.

The pearl-button industry can not get along without the freshwater mussel, and the mussel fishery, which is carried on in the streams of the entire Mississippi Valley, depends largely for its output and operation upon the regular output of the Fairport (Iowa) Biological Station of the Bureau of Fisheries. The freshwater mussel starts life as a parasite in the gills and on the fins of fishes, and the Fairport laboratory makes it a part of its business to infect fishes with these parasites. In the fiscal year 1915 over 345,000,000 larval mussels were thus planted in the Mississippi River and its tributaries in Iowa, Wisconsin, Indiana, and Arkansas. To do this more than 207,000 fishes were infected and then liberated. Over 50,000 of these fishes were rescued from overflowed lands. Thus these latter fishes were not only saved, but they were put to work distributing the young mussels through the whole basin of the Mississippi River. The parasite does the fish no harm. The fish merely acts as a means of cheap transportation for the mussels to the places where they mature and become useful to commerce. This work is now in its third year and its utility is beyond question. In it the science of biology is made the basis on which is founded a practical fishery of large importance, on which in turn an important manufacturing industry depends. This industry is comparatively new in this country. Formerly our whole supply of pearl buttons came from abroad. A little parasite carried about by fishes in the Mississippi River has thus altered an entire economic process and made pos-

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sible a new industry with an output of many millions of dollars and employing many thousands of men, women, and children. Thus is justified the wisdom of Congress in providing a station for scientific research in advance of the known extent of its immediate utility.

I have spoken of rescued fishes. An important branch of the operations of the Fisheries Service is the rescue of young food fishes from the lakes and bayous of the overflowed Mississippi and Illinois Rivers and their tributaries. Operations were last year carried on at stations in Wisconsin, Iowa, Minnesota, Illinois, and Mississippi. In all, over 8,000,000 fish were thus salvaged. Over 500,000 of these were delivered to applicants and deposited in public waters, these distributions involving 34 carloads of fish. Other fishes of many kinds to the number of about 7,800,000 were rescued from landlocked waters and returned to the main rivers. Many, if not most, of these fishes would have perished from drought or from cold in winter if allowed to remain where they were found.

The sea mussel is good to eat and is found in great abundance on our coasts. Millions of bushels of these sea mussels have been growing in the bays and estuaries of our Atlantic and Pacific coasts every year, but, being ignorant of their actual value, we have been wasting a food resource, worth possibly a million dollars annually, by failing to utilize it. This is a very strange state of affairs when we realize that in Europe for centuries the sea mussel has been one of the most highly regarded shellfishes. France alone produces about four hundred million pounds annually and imports many millions more to satisfy the demand of the Parisian restaurants.

The investigators of the Bureau of Fisheries made chemical analyses of the mussel to determine the available food principles present, conducted metabolism experiments to determine the rate of digestion and the amount of nourishment absorbed by the body, and assured themselves that no poisons were present in the flesh. Then palatability experiments were made by having the bivalve served in different ways to the boarders of a large dining hall located near the Woods Hole laboratory. Persons who ate them were questioned concerning their texture, flavor, and the way they agreed with them, and the testimony was recorded. The actual cost of collecting and preparing the mussels for food was also determined.

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The investigation revealed the surprising fact that the sea mussel, so long ignored by Americans, is superior to many aquatic articles which are commonly eaten. Hundreds of persons have pronounced it to be equal in flavor, or even superior, to the oyster; it is easily digested, has high nutritive value, is always in season, and is exceedingly abundant and general in its range. Especially for persons living on the coast is it an excellent cheap food. Continued experiments revealed that the sea mussel is peculiarly adapted to preservation if proper care is exercised, and when canned or pickled will retain its flavor for months.

With these facts in hand, a campaign of education was started in Boston and vicinity in 1914 for the purpose of making known the qualities of the sea mussel. We were fortunate in securing the enthusiastic support of the president of the Boston Chefs' Club, through whom practically every first-class local hotel, club, and restaurant was induced to put sea mussels on the bills of fare, and we furnished small lots of mussels free of charge, with the understanding that they were to be given a conspicuous place and patrons were to be urged to order them. At the same time a circular containing a popular account of the mussel, with approved recipes, was extensively distributed. Printed placards extolling mussels were provided for wholesale and retail merchants who would handle mussels obtained through the Bureau from beds whose sanitary condition was above suspicion. A barrel of mussels was placed in every police station in Boston for free distribution to the members of the force, and next day every policeman in the city, as he went about his beat, was advertising the qualities of sea mussels. Pushcart venders carried this cheap and wholesome food among those who did not frequent hotels, clubs, and restaurants. Lectures were delivered and mussel dinners were arranged by agents of the Bureau, a lecture sometimes preceding a dinner. In a short time the press of Boston, Lowell, Worcester, Providence, and other cities was giving the sea mussel daily attention.

The outcome of all this has been that the neglected sea mussel has become a regular and almost staple article of food in a number of eastern seaboard cities, that its reputation is extending to other cities, and that a permanent and growing mussel fishery has been established.

The fishery for sea bass, or black fish, on banks lying off the coast of North Carolina has developed well during the last fiscal

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year. The largest bank has been buoyed and new ones have been discovered by the use of the steamer *Fish Hawk*.

The completion of the Grand Trunk Pacific Railway to Prince Rupert, British Columbia, provides a shorter line than has heretofore existed between the eastern and central parts of the United States and Alaska. Special efforts have been made by the Canadian authorities to attract to this route the large supplies of fresh fish, chiefly halibut, caught in Alaskan waters and consumed largely in the United States. This caused, naturally, anxiety to the fishing interests of our Northwest Pacific States, for the reason that Prince Rupert is 500 miles nearer to the Alaskan fishing lines, whence the supply has chiefly come, than is Seattle, which is the headquarters of the halibut fleet. This, of course, would involve the increased sailing of 1,000 miles if the product was to be handled from Seattle as heretofore. It became important, therefore, to determine whether a new source of supply for halibut could be found nearer to our own ports, sufficiently abundant and regular to warrant the establishment of a definite fishery.

The steamer *Albatross*, with her regular crew supplemented by some experienced halibut fishermen, began this work in 1914 and has carried it further during the summer of 1915. Meanwhile the discoveries made during the previous fiscal year have been charted and a report thereon with maps has been published. As a result, during the first two weeks of June, 1915, over 800,000 pounds of halibut were taken from these new banks, which are located close to our shores and near the ports of Oregon and Washington. New banks, furthermore, have been discovered directly off the mouth of the Columbia River where none was supposed to exist, and the survey of these was promptly taken up and was finished before this report was written. Its results will be promptly published. Certain banks have been definitely located which were only known by rumor, and fishery trials have been made thereon to show the commercial possibilities in halibut and other fisheries. It may be said that a new source of supply for halibut has already been developed and that this same source will be of greater value in the future for a supply of other fishes not now in demand.

The tilefish is said by Webster's dictionary to be extinct, but it is not. It exists over many hundreds of square miles in large quantities and is a deep-sea fish of great food value readily obtained. It is the purpose of the Fisheries Service to develop this fishery without delay.

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Detailed information has been collated of the great high-sea fisheries centering at Boston and Gloucester and monthly bulletins have been issued to the trade. These records now cover many years and are invaluable for showing the condition and trend of our important offshore fisheries and the relative value of the grounds to which our vessels resort. During the calendar year 1914 such vessels brought into Boston and Gloucester 7,598 cargoes of fish, aggregating 162,589,000 pounds, valued at $4,395,000. Compared with 1913 there was a decrease of 1,231 cargoes, an increase of 372,000 pounds, and a decrease of about $588,000 in value.

The report on the New England otter-trawl fishery was completed and presented to Congress on January 22, 1915.

Vessels.

In lieu of the present method of appropriation for the officers and crews of the vessels of the Bureau of Fisheries, under which each position is made statutory, it has long been felt that greater efficiency will result from a lump-sum appropriation for this service.

If Congress at its next session will authorize civilian crews for the *Albatross* and *Fish Hawk*, this will be a very favorable time for the reorganization of the personnel and pay of the entire vessel service. The matter of the complement and pay for the various vessels has been carefully considered, with a view to the minimum needs and to the ratings in the vessel service of other bureaus of the Government and in the merchant marine; and it can be shown conclusively that, in addition to giving the Bureau a more elastic organization, permitting transfers as occasions warrant and the laying off of men when not needed, there will be a very substantial saving to the Government, even on the basis of full complements of crews. This saving may be shown as follows:

Pay and subsistence of Navy officers and crew on *Albatross* and *Fish Hawk*..		$102,000
Present pay of regular employees on other vessels of the service.....		43,160
		145,160
Proposed pay of officers and crews of all vessels of the service, including substitution of civilian for Navy crews on *Albatross* and *Fish Hawk*.....	$95,000	
Proposed allowance for subsistence.....	22,995	
		117,995
Annual saving to the Government.....		27,165

In view of the foregoing, the Department recommends that a lump-sum appropriation be substituted for specific appropriations

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for the salaries of officers and crews of our vessels in substantially the following terms:

For the compensation of all necessary employees on vessels, including the pay of civilian crews of the *Albatross* and *Fish Hawk*, which vessels have heretofore been manned by the Navy, except scientific and clerical staff, and including commutation of rations at rates to be fixed by the Secretary of Commerce at not to exceed 50 cents per day to each person, $117,995.

An examination made by the steamboat inspectors of the hull and machinery of the steamer *Osprey* shows that the vessel is in such bad condition as to be quite unworthy of repair. An estimate therefore has been submitted for replacing her with a more modern and economical steamer for essential work in the waters of southeastern Alaska. It is more than doubtful whether the *Osprey* can be used even in quiet waters long enough to have her successor purchased or built before she gives out entirely. Congress will therefore be asked to make the appropriation immediately available.

Marine Fishery Investigations.

The foremost position of the oyster among food products derived from the water, the readiness with which it lends itself to artificial cultivation, and the large extent of barren bottoms that may be made productive through human efforts make it preeminently fitting for the Bureau to utilize its facilities in attacking the practical problems of the industry and in determining the suitableness of bottoms now barren for oyster farming. Investigations bearing on the unsolved problems of propagation, of fattening of oysters, and of the causes of "greening," which renders such oysters unmarketable, are being prosecuted at the Woods Hole laboratory. The possibilities of a higher development of oyster culture on the Pacific coast are receiving attention, and studies are being directed to acquiring the necessary knowledge of the life history and conditions of development of both the native and the introduced eastern oysters. In continuation of its practice of cooperation with State authorities and in accordance with the authorization and direction of Congress, the Bureau has conducted a survey of Apalachicola Bay, Fla., to determine the extent of natural oyster beds and of barren bottoms suited to oyster culture. The steamer *Fish Hawk* was assigned to the survey.

The acquirement of a reasonably complete knowledge of the development of fishes from egg to adult, of their food, habits, and enemies, and of the physical conditions influencing their

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movements is fundamental, without which progress in the fishery industry comparable to that made in the development of other important food industries is impossible. With this in view, trained workers at the Bureau's marine laboratories and on the auxiliary schooner *Grampus* have been engaged in studying the embryology and larval development of fishes and in collecting oceanographic data bearing on the amount and distribution of the food organisms of important food fishes and on the physical conditions affecting the food supply and influencing the movements of the fishes themselves. In addition, the systematic study of all larval and young fish obtainable is being undertaken, so that it may be possible to recognize the young of any fish at any stage without regard to its lack of similarity to the adult. These data can later be intelligently collated and used as a basis for inferences regarding the migrations and life histories of important food fishes unobtainable in any other manner.

Recent investigations having shown the possibility of gaining additional light on the age and life history of fishes from a study of the markings on the scales, the same problem is being attacked from this angle.

The auxiliary schooner *Grampus* is engaged in making a comprehensive investigation of the life history of the sea herring of the New England coast and in continuing the oceanographic study of the Gulf of Maine. The latter gives promise of producing results having an important bearing on shaping and simplifying future investigations of important food fishes of the region.

Continuing its cooperation with the Coast Guard, an assistant from the Bureau has been detailed for oceanographical observations upon the Coast Guard cutter *Seneca*, engaged in the ice patrol of the trans-Atlantic steamship lanes.

On the Pacific coast the canning of tuna has rapidly developed into an important industry. Unfortunately for its highest development, the tuna can not be counted upon to appear in abundance with any regularity, and the conditions which induce the appearance or disappearance of the fishes are not understood. A preliminary investigation concerning the movements of the tuna has been carried out and a number of fish marked in the hope that the possible recovery of some of these may throw light on their migrations and rate of growth. An adequate investigation can be conducted only with the aid of a seaworthy vessel capable of following their movements in the open sea.

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Fresh-Water Fishery Investigations.

Fresh-water investigations, which follow in the main the methods outlined for solving marine fishery problems, are in progress, and field operations addressed to fresh waters in all parts of the country have been undertaken as usual.

The Bureau has continued its cooperation with the State Geological and Natural History Survey of Wisconsin in a thorough investigation of the fundamental biological and physical conditions of life in inclosed waters. At Madison, Wis., an extended study of the food of selected species of fishes throughout the year is being undertaken. The importance of problems of this character may be understood when it is realized that the abundance of any fish in a given body of water is limited by the minimum quantity of its food present at the time when it is required. The examination of Lake Champlain, begun in cooperation with the Vermont Fish Commission the preceding year, is nearly completed.

As Lake Cooper, formed by the great dam at Keokuk, Iowa, affords exceptional opportunities for learning from actual experience the effect of water-power development upon the general condition of fish life in the larger rivers and for studies on the migration and habits of fishes, the Bureau is endeavoring to continue systematic observations in this region. On the Pacific coast the breeding habits of the salmon of the Sacramento and Columbia Rivers are being studied in the hope of gaining knowledge of practical utility in the conservation and propagation of these fishes.

Believing, as has been already stated, that a desirable and convenient addition to the food supply of the home, together with significant collateral advantages, may be acquired by the rearing of fish in small ponds on the farm, experiments and investigations bearing directly upon the problems confronting owners of such ponds are under way. At the Fairport laboratory bass, bream, and buffalofish are at present under observation. Fry of the buffalofish from eggs artificially fertilized and hatched are being reared in artificial ponds, a hitherto unattempted venture, with encouraging results. As a pond fish, this species has the advantage of attaining a large size, of being without cannibalistic tendencies, and seemingly adapted for practical methods of artificial feeding. These experiments in the artificial propagation and rearing of this species are to be regarded as of particular impor-

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tance, since it is a valuable commercial fish that is regularly diminishing in numbers.

As the correspondence of the Bureau reveals a very widespread interest in the subject of frog culture, the services of a skilled investigator have been secured to conduct a searching inquiry into the feeding habits, rate of growth, and conditions of existence of commercial species. The problem appears to be one of providing such an abundance of food that a large proportion of the young may come to maturity and a desirable rate of growth secured. The Bureau hopes that means may be discovered for propagating the important species on a commercial basis.

By the employment of temporary investigators at its laboratories, the Bureau has made special efforts to investigate the effects of pollution of various sorts, to study the form and life histories of the different kinds of parasites, and to determine the modes of transmission of infection. Congress having made provision for the employment of a fish pathologist, continuous efforts to do justice to the demands of this important field of research will be made.

The Bureau has a natural obligation and desire to give encouragement and advice in the matter of legislative measures of protection and conservation, whenever its aid is solicited. During the past year it has been represented in conferences with the authorities of the States of Florida, Georgia, and North Carolina, and has participated in a joint conference of the State officials of Wisconsin, Minnesota, Iowa, and Illinois with respect to mussel legislation.

Operations at the Fisheries Laboratories.

The facilities of the marine laboratories at Woods Hole, Mass., and Beaufort, N. C., and the fresh-water laboratory at Fairport, Iowa, have been utilized to the extent of available funds in the prosecution of problems important to the work of the Bureau of Fisheries.

At Fairport experiments to determine the feasibility of rearing certain valuable species of fresh-water mussels in crates in the open river or in ponds are meeting with an encouraging degree of success. Other experiments are devoted to determining the effect upon the mussel beds of some of the common instruments of capture, to the utilization of mussel meats, to the study of the nature and cause of pearl formation, to the relation of the fresh-water mussels to the various species of fish that serve as hosts during the

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period of parasitism, and to various other lines of work of immediate concern to the propagation of fresh-water mussels and the fishery problems of the Mississippi Basin.

At Woods Hole investigations relating to various phases of oyster culture, to the utilization of waste fishes for food and other purposes, to the toxic effect of various mineral salts which may be introduced into the waters either through direct or indirect means of pollution, to the oxygen requirements and metabolism of fishes, and to studies of the life histories, habits, food, and parasitic infection of the fishes have been prosecuted.

At Beaufort, in addition to the regular investigations of the food, habits, and parasitic infection of fishes, studies of protozoa and diatoms, very low forms of animals and plants, respectively, but forms which play a very significant part in the economy of aquatic life and in various direct and indirect ways bear upon the fortunes of life of the larger animals, are being conducted. The investigations respecting the protection of wood against marine borers is still in progress.

In order to assure a greater measure of success in the propagation of diamond-back terrapin, further experiments are now in progress to determine the proper proportions of the sexes for breeding, the best conditions for hatching, and the possibilities of cross and selective breeding and the prevention of mortality. Terrapin hatched in laboratory pounds in 1909 began laying this season, thus completing the life cycle. The practice of winter feeding of the young, which practically doubles the rate of growth for the first year, and a recent change of food which further accelerates growth, may shorten the life cycle of six years of the first experimental brood.

The transfer of title for the site of the new marine biological station at Key West, Fla., is expected to be effected in the near future. An additional appropriation is needed for the construction of this station.

Alaskan Fisheries.

The season of 1914 was the most prosperous in the history of the general fisheries of Alaska. The products were valued at $5,500,000 more than those of the previous season. The catch of salmon was the largest ever made, and was noteworthy for the enormous output of redfish in the Bristol Bay region.

In 1914 the fishing industry of Alaska gave employment to 21,200 persons, of whom slightly over 4,000 were natives. The

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investment in the fisheries was approximately $37,000,000, of which $31,894,000 represented the salmon industry. The catch of salmon aggregated 54,650,000 fish, from which there were prepared 4,056,000 cases of canned fish valued at $18,920,000, and miscellaneous products valued at $638,000. The total value of the fisheries products proper in 1914 was $21,243,000, which amount exceeded that of any other one year. The number of salmon canneries operated in Alaska in 1914 was 81, as compared with 79 in 1913 and 87 in 1912.

The annual census of red salmon ascending Wood River was omitted in 1914 but was resumed in the season of 1915. The number which ascended the river in 1915 was approximately 249,000, which number was less than that for any other year in which the census has been taken.

During the vear every possible effort has been made to enforce the laws and regulations, and it is believed that as much has been done as possible with the limited personnel provided.

Section 6 of the act of Congress approved June 26, 1906, entitled "An act for the protection and regulation of the fisheries of Alaska," authorizes the limiting or prohibiting of fishing in certain Alaskan waters when in the judgment of the Secretary of Commerce such action is necessary in the interests of the fisheries, but it is required that before any such order shall be promulgated a hearing shall be held at which all persons interested may be given an opportunity to express their views. Two orders made in accordance with this statute are already effective. Recommendations having been made that the Department prohibit commercial fishing in certain other waters, arrangements were made for holding a hearing in regard to the subject at Seattle on October 1, 1915.

In the fiscal year 1914 the five privately owned salmon hatcheries in Alaska liberated 64,897,580 red-salmon fry, thereby earning for their owners tax exemptions on canned salmon amounting to $25,959.03. In the fiscal year 1915 these hatcheries liberated 79,619,500 red-salmon fry, on which the tax exemption is $31,847.80, the basis of exemption being 40 cents per 1,000 fry.

In order that the Department may properly discharge its functions and obligations with reference to the Alaskan fisheries, there should be a general revision of the fishing laws to meet new conditions that have arisen. There have been protracted conferences with fishing and fish-preserving interests of Alaska, looking to the drafting of a comprehensive bill that will regulate and protect

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the fishes and at the same time provide a revenue from the taxation of fishing gear and the prepared products. Among other features of the existing law that require radical treatment is the practice of giving rebates of taxes in proportion to the number of salmon fry liberated from private hatcheries. Such hatcheries should be acquired by the Government at a fair valuation. The proposed measure was introduced in the House of Representatives but failed to become law. It is earnestly hoped that favorable action will be taken at the next session of Congress.

Congress will be asked to provide further facilities for enforcing the fishery laws. Two stanch motor boats are now desired. These will not meet all the requirements, but will fill a more urgent need. When these are provided, they, with the *Roosevelt* and a vessel to replace the *Osprey*, will be a reasonable beginning, and but a beginning, of the means for the supervision which over 20,000 miles of coast require, having a fishery of over $21,000,000 annual value. One can hardly expect in these distant regions that the law shall be greatly respected when the law has not shown sufficient respect for itself to provide respectable means for its enforcement.

In my last report it was mentioned that the Deputy Commissioner of Fisheries, Dr. E. Lester Jones, was, in the spring of 1914, instructed to proceed to Alaska to make an inspection there of conditions affecting the work of the Bureau of Fisheries. His report was submitted on December 31, 1914, and presents in detail, with many illustrations from photographs taken by Dr. Jones and with maps and charts, the facts as he observed them. The report is a valuable contribution to the study of Alaskan conditions. It is available upon request of the Bureau of Fisheries. It shows in a striking way the fearful waste that accompanies what is sometimes called economy. On one page appears a photograph of the fine revenue cutter *Tahoma* lying in the harbor of Unalaska and beneath it a picture of that same vessel a few weeks later with the sea washing over her after she was wrecked on an uncharted rock off Agattu Island, with the American flag floating as an example in this case of what the Government did not do in time to protect its own valuable property.

The recommendations made in the report of Dr. Jones have been given careful consideration. Many of them were included in the fisheries bill (H. R. 21607, 63d Cong.) introduced with the Department's approval at the last session. This bill will be reintroduced into the Sixty-fourth Congress. Some of the recom-

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mendations have already been adopted and carried out so far as facilities and resources warrant. The substance of others has been already treated in this report. Others are still receiving consideration.

The recommendation that at least five new Government hatcheries be built in places not at present receiving the benefit of fish-cultural operations has the cordial indorsement of this Department. It has been the subject of frequent recommendations to Congress. Even if the Government should take over the private hatcheries now in Alaska, there will still be need for these additional ones.

On April 29, 1915, the Legislature of Alaska passed an act imposing additional license fees on certain kinds of business, including fisheries, salteries, fish traps, and gill nets. It at once became apparent that if the Legislature of Alaska exercises this power the result is double taxation on persons engaged in such kinds of business, and further a dual control would exist between the Department of Commerce and the Legislature of Alaska over at least a branch of such kinds of business. The latter condition is the one that primarily concerns the Department of Commerce. The control of the fisheries of Alaska is by law placed in that Department, which is responsible not only for their preservation but also for their growth and development. Clearly, if the Territory of Alaska has a joint right of control over the whole or any portion of such fisheries, the plans of the Department of Commerce for their growth and development may meet with serious interference and the result may be most harmful to the industry. If, for example, the Legislature of Alaska may impose license fees and taxes to an extent that might seriously impair the industry by making it unprofitable, the Department of Commerce, charged with the responsibility of caring for this industry, would be practically helpless.

Not even the possibility of such a situation, much less the situation itself, should be allowed to exist. As long as Congress sees fit to continue the control of the Alaska fisheries in the Department of Commerce, that control should be exclusive. It is respectfully suggested that Congress should either repeal the proviso contained in section 3 of the act of August 24, 1912, which authorizes the Legislature of Alaska to impose other and additional taxes or licenses, or so amend it as to exclude fisheries and kindred occupations in Alaska from its operation. This would leave the law as it stood before the passage of the act of August 24, 1912, and all

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license fees and taxes for the carrying on of fisheries and kindred occupations in Alaska would then be fixed by Congress.

It may be urged that section 20 of the act of August 24, 1912, meets the situation. It reads thus:

> All laws passed by the Legislature of the Territory of Alaska shall be submitted to the Congress by the President of the United States, and, if disapproved by Congress, they shall be null and of no effect.

This provision, however, does not meet the case, for unless by its terms Congress actually disapproves of the acts of the Alaskan Legislature they continue to have the force and effect of law. Applying it to the case under consideration, it would mean that Congress would have to disapprove each and every license tax or law that might be passed by the Legislature of Alaska on the fisheries in that Territory.

There should be no doubt on this important matter, which is respectfully commended to the attention of Congress. The difficulty appears to arise from the possible double interpretation of the provision of section 3 of the act of August 24, 1912 (37 Stat., 512), which establishes the Territory of Alaska.

The sundry civil bill making appropriations for the fiscal year 1915 provided for an increase in the number of wardens in the Alaska Service. This made it possible for the Department to extend to a limited extent its work in the way of protecting the fisheries and fur-bearing animals of Alaska.

The Fur-Seal Herd.

On page 98 of my report for 1914 it was stated that three special assistants of the Department—viz, Mr. Edward A. Preble, of the Bureau of Biological Survey, Department of Agriculture, designated by the Secretary of Agriculture; Mr. Wilfred H. Osgood, of the Field Museum of Natural History, Chicago, designated by the Secretary of the Smithsonian Institution; and Prof. George H. Parker, of Harvard University, designated by the National Academy of Sciences at the request of the President of the United States—were sent to the Pribilof Islands to make a thorough inquiry into the conditions of the fur-seal herd and various questions connected therewith.

Their report was submitted on January 23, 1915, entitled, "The Fur Seals and Other Life of the Pribilof Islands, Alaska, in 1914." This report was transmitted to the Speaker of the House of Representatives, and on February 17, 1915, was also trans-

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mitted to the Committee on Printing of the United States Senate with the request that it be printed as a congressional document. This was done, and the report is Senate Document No. 980, Sixty-third Congress, third session. It also has been printed as document No. 820 of the Bureau of Fisheries, issued June 19, 1915. In this is printed in full the "note verbale" received by the Department of State from the British and Japanese Ambassadors May 29, 1914, and the instructions from the Department of Commerce to the special assistants dated May 26, 1914, together with the letter transmitting their report to the Committee on Printing of the Senate with request for its publication.

The report presents in detail, with illustrations and 24 maps and a bibliography, a full statement of the condition in 1914 of the seal herd, the fox herd, and the reindeer herd belonging to the Government on the islands, and of the facts respecting the community upon the Pribilof Islands, and other related matters.

A copy of the report was sent to each Senator and Representative of the Sixty-fourth Congress with a letter calling especial attention to it. Copies of the report were also sent to the press, to libraries, and to various persons interested in it. It is commended to the thoughtful reading of Congress and of the country.

The Alaskan seal herd was found by these special investigators in 1914 to contain approximately 294,700 animals, of which not less than 93,250 were females of breeding age.

A census of the herd taken by the officers of the Department upon the islands in July and August, 1915, showed a further increase to a total of over 360,000 animals, of which not less than 103,000 were females of breeding age.

On the recommendation of the special investigators, a maximum of 4,500 seals was fixed as the number that might be killed during the summer season of 1914 for the food purposes of the natives. The take, however, was but 2,735. This was found insufficient for a proper food supply at times during the winter of 1914–15, and since better storage facilities have meanwhile been supplied upon the islands a maximum of 5,500 has been fixed as the number which may be slaughtered during the season of 1915. At the date of this report the actual number killed is not known, but it approximates 3,500.

In February, 1915, Congress, by joint resolution, authorized the Secretary of Commerce to postpone the sale of sealskins then in his possession to such time as he might deem advisable. Under

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the law as it existed theretofore, the annual sale of sealskins was required. In the unsettled state of the international fur market arising from the European war a material loss in revenue would have resulted had the sale been forced during the past fiscal year.

There are now in cold storage 3,296 sealskins, to which should be added the number taken from animals slaughtered during the summer season of 1915. If war conditions continue so as to close international markets, it may be necessary to request from Congress authority to postpone the sale of the skins taken this season as was done last year. The Department has under consideration, however, a plan whereby all of these raw skins, those taken both in 1914 and in 1915, may be dressed and dyed in this country by the best process known anywhere for the purpose and not hitherto used in this country, which would result not only in saving the skins from any possible deterioration in storage but would permit their sale as fully dressed and dyed furs of the best quality at prices remunerative to the Government. This would save the purchasers the cost of shipment to Great Britain for dyeing and dressing, as has heretofore been necessary, the expense of reshipment to this country, and the duty heretofore imposed upon them when so reshipped.

The result of this arrangement would be to put into American control the entire process from beginning to end, to bring to this country an industry not existing here before and to save upon this valuable product a large amount of unnecessary expense which has hitherto been imposed thereon by reason of our dependence upon a foreign source for dyeing and dressing.

When commercial killing of fur seals shall be renewed—and the rapid growth of the herd will make that soon both possible and desirable—other products of that herd than the fur skins should have a consideration which has never been given them. The seal carcasses contain materials of economic value which have hitherto been wasted and which are far beyond the power of the native community to utilize. The Department is giving the profitable utilization of seal meat and refuse careful thought. Valuable suggestions have already been made upon this subject by Mr. G. Dallas Hanna and others upon the islands. It is possible that not only may food products be made available but that in other ways the animals will be found to have economic value. To save only skins and waste the rest of the animal is no longer in accord either with scientific knowledge or good industrial practice.

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The Seal-Island Natives.

Reports from the seal islands show a material improvement in the physical, moral, educational, and industrial relations of the natives. Steps have been taken to carry out, as far as practicable, the various recommendations and suggestions of the special investigators with reference to the natives, and still further improvement may confidently be expected as a result of support from Congress.

The use of intoxicating liquors by these natives has always been one of their chief handicaps, and the Government has been singularly derelict in protecting them in this respect from themselves and from outsiders. For years they have been permitted to brew in their houses an intoxicating drink made from the supplies furnished by the Government, and on special occasions they had been regularly served with liquors by Government agents, although this was strictly in violation of regulations. On March 1, 1915, the Department issued a circular order embodying full regulations covering the delivery and use of intoxicating liquors on the Pribilofs, and positively prohibiting, under all circumstances, the giving of such liquors to the natives except as medicine and in religious ceremonies, and suppressing the manufacture of intoxicants by the natives.

An important innovation in the relations of the Government to the natives has been in the method of compensating them for services rendered. Formerly it was the practice to pay cash for such services, and a comparatively large proportion of the appropriation was thus expended. The cash thus acquired by the natives was largely used by them in purchasing supplies at the Government stores, and the sums received from such sales were, under the law, covered into the United States Treasury. There was thus a double drain on an appropriation none too large for the legitimate purposes in hand. Now all able-bodied natives are required to perform some labor, and they are paid therefor in supplies. This arrangement has not been brought about without some difficulty with the natives, but in general appears to be working well. The agent on St. George Island reports that the natives "have both privately and as a body expressed their preference for the present method of issuing all necessary supplies as against receiving pay in cash for all labor and buying with their earnings their food and all other necessary articles."

On the resumption of commercial seal killing, when, under the law, the natives are entitled to compensation for services per-

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formed in various capacities, arrangements should be made by which the expense thus incurred shall be deducted from the selling price of the sealskins and not from the appropriation for the maintenance of the fur-seal service.

Supplies for the Pribilof Islands.

A more economical method of procedure in obtaining supplies for the Pribilof Islands was instituted in 1914–15. In the past the comparatively large quantities of general supplies for natives and Government employees have been bought either without competition or on more or less informal proposals. During the past year comprehensive schedules were printed and distributed to prospective bidders in Seattle, San Francisco, St. Louis, Chicago, New York, Boston, and other cities, and a material saving resulted from the strictly competitive proposals which were received.

A shortage of certain supplies on the islands having developed in the winter of 1914–15, a small shipment was made on a chartered fishing vessel. Whenever practicable a vessel should be sent to the islands each winter, not only for the purpose of carrying supplies but for taking mails and for its general effect on the morale of the natives. When the Department has its own vessel for this service, the almost prohibitive cost of transportation to the seal islands that has heretofore been encountered will be overcome, and the unfortunate results which have arisen in large part from the isolation of the native community and the officers controlling them during six months of the year will pass away. For this purpose and for the general service of the fisheries upon the Alaskan coast the Department bought for the Bureau of Fisheries on February 25, 1915, the well-known North Polar steamer *Roosevelt*. She has been improved by providing equipment for burning fuel oil under her boilers.

Upon careful inspection made by officers of the Steamboat-Inspection Service and of the Lighthouse Service, and after a trial trip, the vessel seemed to be in good condition for the voyage through the Panama Canal to her post of duty. After leaving New York, however, en route to Norfolk, there to take a cargo of coal to the islands, unforeseen difficulties arose in her boilers and engines which required that same be overhauled, and that work is now progressing at the Norfolk Navy Yard.

The *Roosevelt* will be of untold value in Alaskan waters. She is peculiarly fitted for coping with winter conditions on those seas.

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Her use will save the cost of chartering vessels to carry supplies back and forth to the islands, a matter which has alone been an expense of $20,000 or more a year. She will bring back the fur-seal and fox skins and other products from the islands. She will afford a means of communication throughout the year to that isolated community, and apart from this will relieve the entire Fisheries Service from the humiliating necessity of borrowing vessels to make inspections from the persons to be inspected, and will for the first time provide for the extensive fisheries of Alaska the supervision which the law contemplates but which has never heretofore existed. Able to navigate the rough waters of Alaska at any season, she will be a safeguard to the Government interests and her use will prove of great public and private value.

Fur-Bearing Land Animals.

The Department should be relieved of custody over the fur-bearing animals whose pursuit does not constitute a fishery.

Very careful study was given to the subject by an interdepartmental committee of the Departments of Commerce and Agriculture composed of Dr. E. Lester Jones, then Deputy Commissioner of Fisheries, Mr. Ward T. Bower, agent in charge of Alaska Service of Bureau of Fisheries, both representing the Department of Commerce, Mr. E. W. Nelson, Assistant Chief of Biological Survey, and Dr. T. S. Palmer, Assistant in Charge Game Preservation, Biological Survey, representing the Department of Agriculture. This committee on April 10, 1915, presented a comprehensive report recommending—

(1) That Congress be requested to provide by appropriate legislation for the transfer to the Department of Agriculture of jurisdiction over terrestrial fur-bearing animals in Alaska.

(2) Such legislation should provide that the Department of Commerce exercise exclusive jurisdiction over fisheries, fur seals, sea otters, walrus, sea lions, whales, porpoises, and other aquatic mammals of that Territory, and for this purpose should retain its present personnel.

(3) That pending legislation by Congress no change should be made in the Executive order for the Aleutian Islands Reservation, but that the departments should continue to cooperate as heretofore in administering the various interests on this reservation.

The two departments will support legislation having for its purpose the carrying out of their recommendations. Certain very absurd conditions have arisen out of the present state of the law.

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For example, the black bear, being called a fur-bearing animal, is under the jurisdiction of the Department of Commerce. The brown bear, though he has fur on him, being called technically a game animal, is under the jurisdiction of the Department of Agriculture. If, now, black bears have brown cubs, under whose jurisdiction is the brown cub of the black bear? This case has actually arisen.

I respectfully urge the passage of legislation in accord with the interdepartmental committee's report to put an end to this.

In the winter of 1913–14 the Government herds of blue foxes on the seal islands yielded 256 pelts and the white foxes 25. In the winter of 1914–15 the number of blue-fox pelts was 253 and of white-fox pelts 40. These will be sold in the fall of 1915 at public auction.

The Department of Commerce acknowledges with gratitude the continued able assistance of the cutters belonging to the Coast Guard. Their patrol in the season when pelagic sealing operations are possible has been of great value, and they have rendered valuable service also in transferring officers and mails to and from the Pribilof Islands and in transporting small quantities of supplies.

The wireless telegraph stations maintained by the Navy Department on St. Paul and St. George Islands have been constantly used and are of great value. The Fisheries Service now requires weekly reports of conditions upon the islands by means of the wireless service.

After conference with the Department of Agriculture, new regulations for the Alaskan Islands Reservation were adopted by the Department of Commerce governing fishing and the taking of fur-bearing animals.

The recent expansion in the business of fur farming has developed a number of conditions which under existing law the Department is unable to regulate properly. When the present law was enacted, practically the only reason for capturing wild fur-bearing animals was to secure their pelts, and the authority to regulate the capturing of live animals and the shipping of them from the Territory was not granted to the Department. Undoubtedly there is a great deal of waste of young fox life due to the indiscriminate digging of young animals from their nests by irresponsible persons for use on fur farms. Apparently the only regulations for which the Department could secure enforcement are those which concern the killing of fur-bearing animals. Bills

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for the purpose of providing remedies for the present unsatisfactory condition will be introduced in Congress, and it is hoped the additional legislation may soon be had.

In May, 1915, the Department revised the existing regulations. They became effective June 1, 1915, and were published as Department Circular No. 246, third edition.

The Department has continued the regulation that all shipments of furs from Alaska shall be reported to the Commissioner of Fisheries. All reports of shipments by mail are certified by the postmasters at the shipping points. Express and commercial companies have shown a commendable spirit of cooperation in the matter of shipments made through their offices. Compilations of these shipments are made annually for a period extending from November 16 of one year to November 15 of the following year, the idea in compiling the statistics for those periods being to make the results correspond as nearly as possible with the actual take of pelts in each open season. On the whole the statistics indicate that the quantities of furs shipped from Alaska are being maintained fairly well. A few comparisons for the year ended November 15, 1914, with the year ended November 15, 1913, are made: Ermine, 6,873 in 1914, 6,559 in 1913; red fox, 14,967 in 1914, 10,820 in 1913; white fox, 6,530 in 1914, 3,756 in 1913; lynx, 6,930 in 1914, 4,772 in 1913; marten, 6,497 in 1914, 9,682 in 1913; mink, 35,623 in 1914, 47,062 in 1913; muskrat, 101,202 in 1914, 163,616 in 1913; land otter, 1,008 in 1914, 1,300 in 1913. It must be recalled that the fall of 1914 witnessed an unusual depression in the fur trade, which may have caused a decrease in the number of shipments which would otherwise have been made.

I venture to suggest that it is desirable a joint committee of Congress should visit the Pribilof Islands in the summer of 1916. The Government property there in the seal herd, the fox herd, and the reindeer herd is of great and increasing value. The suggestion has been made to the Department by well-informed parties that Dutch Harbor should be purchased for Government uses. The condition of the housing of the native community is a matter of serious importance, and so is the provision of the necessary storage and semipublic buildings which in that climate are urgently required and which should be put upon a much more satisfactory basis than they ever have been. The problems presented by the management of this Government property are not only of national but of international importance. There has been far too much bitterness and attack in debating them,

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far too much of the spirit of mutual recrimination. The subject is one which should be treated in calm judicial spirit in accordance with the facts and without regard to prejudice. The problems are those of the present and of the future. With these, and with these alone, this Department is concerned. I do not consider that the past is within its scope. It seems to me, however, of urgent importance that Congress should see for itself by the eyes of its own Members just what the conditions are. To that end the Department of Commerce will willingly contribute in any way within its power.

The work of the Bureau of Fisheries involves the direct application of scientific research to human life. It takes the results of biology and uses them to sustain the pearl-button industry. It searches into the feeding habits of fish and as a result publishes information concerning those which are active consumers of mosquitoes. It furnishes for the home practical cookbooks telling how to use the salmon, the tilefish, the oyster, and the sea mussel. It is studying the life history of the hard clam, or quahog, to determine whether it can be cultivated in Chesapeake Bay and elsewhere. It strives to utilize unused, unknown, or wasted articles of food or those having economic value. It will ask Congress in the coming session for a fund for instructing those who depend upon the fisheries how best to conserve the supply upon which their own living depends. In this effort it will have the support of the fish commissioners of all the coastwise States.

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BUREAU OF LIGHTHOUSES.

Five years having passed since the Lighthouse Service was reorganized under the law which took effect July 1, 1910, a brief review of the progress of the lighthouse work in the United States during that period is given.

Progress Under New Organization.

There were on June 30, 1910, 11,713 aids to navigation. On June 30, 1915, there were 14,544. This is a net increase of 2,831, or 24 per cent, and is an average annual increase of 566 aids. This, it will be seen, is an average increase of about three new aids every two days in the year or almost two new aids daily every working day. These aids include lighthouses of all sizes, light vessels, lighted buoys, post lights, unlighted buoys of all kinds, submarine bells, fog signals, and daymarks.

Careful attention has been given to improving apparatus and equipment to accord with the best modern practice of coast lighting. In this process gas buoys, which are more valued by mariners than any other recent addition to coast lighting, have been increased from 225 in 1910 to 479 in 1915, an addition of 254. Oil-vapor lamps have been greatly appreciated because of their superior brilliancy. The number of such installations at light stations has increased from 80 in 1910 to 286 in 1915. This is a gain of 206 stations, or over 250 per cent. Most of the primary coast lights are now provided with oil-vapor lamps.

Steady progress has been made in changing fixed lights and flashing or occulting lights in cases where doubt might occur, and 169 lights have been so improved in the five-year period.

There has been a strong demand arising from urgent need for improved lighting of the Alaskan waters, and the number of lights on the coast of Alaska has been increased from 37 in 1910 to 112 in 1915, a gain of 75, or over 200 per cent. The total number of fog signals, including sounding buoys, has grown from 844 in 1910 to 1,044 in 1915.

During the five years since 1910 the organization and business methods of the Service have been thoroughly examined and revised wherever it appeared desirable to do so. In securing in-

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creased effectiveness and economy the welfare of the personnel has been constantly considered.

The general organization of the Lighthouse Service remains the same as described on page 109 of my report for 1913, and is given in full on page 564 of this volume. There were on June 30, 1915, 5,792 authorized positions in the Lighthouse Service. Of these, 123 were in the technical force, 145 in the clerical and office force, and 5,524 connected with depots, lighthouses, and vessels.

Aids to Navigation.

During the fiscal year ended June 30, 1915, there was a net increase of 359 in the total number of aids to navigation maintained by the Lighthouse Service, including 74 lights above the order of minor lights, 1 light vessel, 8 fog signals, 2 submarine bells, 26 daymarks, 25 lighted buoys, 170 unlighted buoys, and 53 minor lights.

Fixed lights were changed to flashing or occulting at 29 stations. The illuminant of 21 lights was changed to incandescent oil vapor, the illuminant of 23 lights was changed to acetylene, and the illuminant of 2 lights was changed to oil gas. Two new light vessels were established during the year. On June 30, 1915, there were maintained by the Lighthouse Service 14,544 aids to navigation, including 5,155 lights of all classes, and 577 fog signals, of which 50 are submarine signals. The systematic methods of improvement and the use of modern apparatus in increasing the number and brilliancy of aids have been of value to the safety of commerce.

The following are some of the more important aids which have been established or materially improved during the past fiscal year:

New light vessels, with flashing lights and compressed-air fog signals, were established at Poe Reef, Straits of Mackinac, Lake Huron, Mich., and at Buffalo Entrance, Lake Erie, N. Y. Both of these were former light-vessel stations, which had been temporarily discontinued, one having been discontinued during the fiscal year.

New light and fog-signal stations have been constructed at Brandywine Shoal, Del., and Thimble Shoal, Va., to replace former structures.

A complete new system of lighted aids was established at the approaches to the Cape Cod Canal, Mass.

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Important coast lights changed from fixed to flashing or occulting: Cape Sarichef, Unimak Pass, Alaska; Ediz Hook, Juan de Fuca Strait, Wash.; Diamond Head, Oahu, Hawaii; Fowey Rocks and Sombrero Key, Florida Reefs, Fla.

Fog signals established: Gallups Island, Boston Harbor, Mass. (electric bell); Fort McHenry, Baltimore Harbor, Md. (electric bell); Volusia Bar, St. Johns River, Fla. (bell); Point Blunt and Point Stuart, Angel Island, San Francisco Bay, Cal. (electric sirens). The former third-class reed horn at Stratford Shoal (Middle Ground), Long Island Sound, N. Y., was changed to a first-class automatic siren.

Submarine bells established: South Pass gas and whistling buoy, Mississippi Passes, La.; Frying Pan Shoals gas and whistling buoy, N. C.; Martins Reef Light Vessel, Lake Huron, Mich.

Important gas buoys established: Buzzards Bay, Mass. (2); Cape Cod Canal approach, Mass. (bell); Cornfield Point, Long Island Sound, Conn. (whistle); Cape Henry, Va. (whistle); Wimble Shoal, north of Cape Hatteras, N. C. (whistle); Fernandina Entrance, Fla.; Smith Shoal, Glama Wreck, and New Ground Rocks, Florida Reefs, Fla. (each with whistle); Point Arenas, Vieques Passage, P. R.; Hein Bank, Juan de Fuca Strait, Wash. (bell); South Channel Columbia River Entrance, Oreg. (whistle).

Systems of minor aids and buoyage extensively rearranged or improved in important localities: Hudson River, N. Y.; inland waterway, N. J.; Chincoteague Bay, Va.; Newport News Channel, Va.; inland waterway, Fernandina to St. Johns River, Fla.; Santa Rosa Sound, Fla.; Black Rock Channel, Buffalo Harbor, N. Y.; Klag Bay, Alaska; Grays Harbor, Wash.; Yaquina Bay, Oreg.

Flashing acetylene gas lights established: Stockton Harbor Range, Me. (2 lights); Buzzards Bay, Mass. (12 lights); Egmont Key Range Front, Fla.; North Bank, Cedar Keys, Fla.; Ashtabula Harbor, Ohio (2 lights); Conneaut Breakwater, Ohio; Livingstone Channel, Detroit River, Mich.; Manistique Harbor, Mich.; Saugatuck Harbor, Mich.; Oconto Harbor, Wis.; Rugged Island, Resurrection Bay, Alaska.

The amount of hurricane and ice damage during the fiscal year was relatively small, but a number of unusually heavy winter and spring gales, particularly on the Atlantic coast, damaged various vessels and stations. Among these may be mentioned the Atlantic gales of December 5 and 6, 1914, January 12 to 14, and April 2

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to 4, 1915; also the Pacific gale of April 29 and 30, 1915, the total aggregate damage amounting to approximately $50,000.

The systematic relief of all buoys at least once a year was carried out throughout the Service with a greater degree of completeness than in prior years, particularly in those districts where difficulties had been previously experienced on account of the large number of inaccessible buoys.

A systematic plan was developed for keeping records of extinguishment of various types of automatic gas lights, both on fixed and floating aids, with arrangements for reporting the percentage of nights extinguished as compared to the entire period under observation. This will be useful in compiling information as to the comparative efficiency of various types in service and the degree of reliance which may be placed on such lights.

Further improvements in publishing notices to mariners were undertaken during the year by adopting a more concise form, giving only such facts as are of principal interest to the mariner.

The light lists for the Atlantic, Lake, and Pacific coasts were each issued in octavo form, which is believed will increase their usefulness to mariners. Special effort was made to publish the seacoast light lists as soon after the first of the calendar year as possible, and the Lake list was issued immediately prior to the opening of the season of navigation.

Aids to navigation at Guantanamo Bay, Cuba, at the American Samoan Islands, and the island of Guam are maintained under the supervision of the naval commandants at these places through allotments made from the appropriations for the Lighthouse Service. The approximate annual expense for the maintenance of aids at all three is a total of $6,500.

The United States assists in maintaining one lighthouse outside of its territory, this being at Cape Spartel, Morocco. The sum of $325 per annum is carried in an appropriation for the Department of State for this purpose. The lighthouse was constructed at the expense of Morocco, but is operated by a committee of consuls of the United States, Austria, Belgium, Spain, France, Great Britain, Italy, Netherlands, Portugal, and Sweden under a convention which has been in force since March 12, 1867.

Alaska.

The total number of aids to navigation in Alaska, including lights, fog signals, buoys, and daymarks, in commission at the close of the fiscal year ended June 30, 1915, was 338, including

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112 lights. The following table, which gives the total number of aids to navigation on June 30 of each year named, illustrates the progress in establishing aids in the Territory:

Aids.	1910	1911	1912	1913	1914	1915
Lights	37	72	85	93	108	119
Fog signals	9	10	10	10	10	10
Buoys	84	105	132	136	157	167
Daymarks	30	29	38	40	44	49
Total	160	215	265	279	319	338

The act of October 22, 1913, made an appropriation of $115,000 for a light and fog-signal station at or near Cape St. Elias, and an item for the establishment of aids to navigation and improvement of existing aids in Alaska in the sum of $60,000 was included in the sundry civil act approved August 1, 1914. Work on both of these objects was started as promptly as conditions would permit, and satisfactory progress on each had been made up to the date of this report.

The act of January 25, 1915, appropriated $250,000 for the new lighthouse tender *Cedar*, urgently needed for the work of the Service in Alaska. In order to take advantage of market conditions, plans and specifications were prepared in the shortest practicable time. Copy of the specifications was sent to the printer March 1, 1915, proposals were issued March 11, bids were opened April 27, and the contract was awarded May 4, 1915, to the Craig Shipbuilding Co., Long Beach, Cal., in the sum of $234,500.

The *Cedar* will be the largest vessel in the Service and is especially designed for working in the rough seas off the coast of Alaska. She is designed to carry four light quick-firing guns in case her services should be needed for patrol work. Pending her construction the tender *Kukui*, an able seagoing vessel, was transferred from the Hawaiian Islands to Alaska in order to care for the necessary work on the Alaskan coast.

The new tender *Fern*, for service in the inside waters of southeastern Alaska, was completed during the fiscal year and immediately assigned to duty.

Administrative Methods and Economies.

A second conference of lighthouse inspectors, authorized by me, was held during February, 1915. The program followed the same general lines as last year, and the results are believed beneficial to the Service.

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A new edition of the Regulations for the Lighthouse Service was approved by the Department and issued to take effect October 1, 1914. Revised rules providing for progress payments for 75 per cent of work done, under suitable restrictions and safeguards, were put in effect.

The practice of systematic inspections of the various lighthouse districts by the general inspector, examiner, and officers of the Bureau was continued with good results.

The standard method of cost keeping was continued during the fiscal year.

Instructions were issued the inspectors in reference to the exchange of blue prints of new devices, methods, etc., among the various district offices, in order that all offices may be kept promptly informed of any desirable improvements or apparatus.

Instructions in reference to the more general use of mileage books for employees when traveling on official business were issued for guidance whenever economy might be thereby secured.

In order to facilitate assignment of employees from one lighthouse tender to another, as the interests of the Service require, the Department authorized the regarding of all appointive positions on tenders as in the Lighthouse Service at large, instead of on the particular vessel, as was formerly the case. This will greatly lessen the number of papers required to be prepared when vessels are transferred from one district to another.

With a view to preliminary training for light keepers prior to their permanent assignment to light stations, arrangements have been made for the appointment of a few additional keepers for a trial system of general training and instruction for such employees in selected districts.

The custom of issuing lists of spare property available for transfer in all lighthouse districts was continued with good results.

The publication of the monthly Lighthouse Service Bulletin was continued throughout the year, with beneficial results.

The exhibit of the Lighthouse Service at the Panama-Pacific International Exposition at San Francisco was installed. This included the lens and lantern for the lighthouse being erected at Cape St. Elias, Alaska.

Engineering and Construction.

New works of principal importance under special appropriations completed during the fiscal year are as follows: Cape Cod Canal entrance lights, Mass.; Rondout (North Dike) N. Y.,

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light and fog signal; Miah Maull Shoal, N. J., light and fog signal; Brandywine Shoal, Del., light and fog signal; Thimble Shoal, Va., light and fog signal; Cape Fear River lights, below Wilmington, N. C.; Oconto Harbor light, Wis.; and Point Arena, Cal., improvement of road.

Other important work in progress at the close of the fiscal year includes Atchafalaya Entrance Channel, La., aids to navigation; Galveston Jetty, Tex., light station; Navassa Island, West Indies, light station; Ashtabula, Lorain, and Cleveland, Ohio, light stations; Ashland, Wis., light and fog signal; Manistique, Mich., light and fog signal; and Cape St. Elias, Alaska, light and fog signal.

Extensive study has been given to the protection of exposed shores of various lighthouse reservations from erosion by the sea, and good results have been obtained in a number of instances by the judicious location of bulkheads, sea walls, or groynes.

A study was also made of the effects of sea water on concrete piles in lighthouse works in the South Atlantic and Gulf coasts.

A new type of single-pile pipe beacon, carrying a latticed cage daymark, was developed and several placed in service at a moderate cost.

Careful attention has been given in the matter of designing, to develop permanent and fireproof structures in all cases where available funds will permit.

Improvement of Apparatus and Equipment.

Service tests have been made of spar buoys made from logs cut on lighthouse reservations on the Great Lakes. The quality of the timber is good, and a considerable saving in cost has also been effected.

Improvements have been made in connection with electric sirens, to avoid the rising and falling notes and the wearing of the bearings due to continued starting and stopping of the mechanism.

Experimental installations were made of temporary unwatched gas lights for winter use at certain isolated stations on the Great Lakes, permitting the keepers to leave under safer conditions and at the same time giving service to belated mariners after the close of the regular navigation season. Three such installations were in commission on Lake Michigan last winter and gave good results. Consideration will be given to extending this arrangement to other important offshore Lake stations.

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A new type of electric flasher for gas lights was developed and placed in service. This device is operated by means of dry cells, which control magnets opening and closing the gas valve, as contacts are made by detachable cams on a master clock. Any desired characteristic may be obtained by the attachment of properly arranged cams.

In order to facilitate the landing of supplies and mail at certain isolated Alaska stations, line-throwing guns, similar to those in use by the Coast Guard, have been installed as part of the station equipment. Experiments are also in progress to determine the best gun of the kind for use on board lighthouse tenders for passing lines to other vessels in heavy weather. It is intended to equip all the larger tenders with such guns as rapidly as possible.

A fog-signal installation, with sirens 900 feet distant from the compressors, has been in successful operation. The blasts are given by pneumatic valves controlled by solenoids, which in turn are energized by a battery and the time intervals regulated by a timing device in the power house. The entire installation is in duplicate, and so arranged that either siren may be operated at will by means of switches at the power house.

A two-tank cast-iron breakwater light has been designed, with the object of supporting the lantern and tanks at such heights that waves breaking over the breakwater will have relatively slight effect upon the structure.

Service tests have been made of new brands of red paint, particularly in localities where the action of the elements has been found severe owing to unfavorable conditions of heat and moisture. These tests have been successful, and such paints, although higher in cost, give the aids so painted a very conspicuous and bright appearance.

Appropriations.

In addition to the maintenance appropriations for the current fiscal year, appropriations for the following special works were made by Congress during the fiscal year 1915:

Carpenter shop for the General Lighthouse Depot, Tompkinsville, N. Y.	$23,000
Completion of Kilauea Point light station, Kauai Island, Hawaii	3,000
Aids to navigation in Alaska	60,000
Aids to navigation at the entrances to the Cape Cod Canal, Mass	50,000
Lighthouse tender for general service	250,000

In submitting estimates for the maintenance of the Service for the fiscal year 1917 reasonable consideration has been given to

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the growth of the Service, and particularly to the fact that an increase is essential in the appropriation for salaries of vessels in order to keep in commission the present vessels of the Service and to man those under construction when completed, and also to the inadequacy of the salaries at present paid to the lighthouse inspectors.

Besides the estimates for maintenance, estimates for 36 special works have been submitted, aggregating $2,002,300. These include—

2 new lighthouse tenders.
2 new light vessels.
9 new light and fog-signal stations.
3 new light stations.
2 new lighthouse depots.
6 items for establishing or improving aids in general localities.
1 item for a new system of harbor or channel lights and other aids.
6 items for improvement of light or fog-signal stations or of groups of aids to navigation.
4 items for improvement of lighthouse depots.
1 item for light-keepers' dwellings.

Special attention is invited to the fact that the appropriations for special works in the Lighthouse Service for the two fiscal years 1915 and 1916 total only $386,000, whereas the average amount for the 10 preceding fiscal years was $946,927 annually. A large part of the items submitted are the same as those submitted last year, for which appropriation has not yet been made, although a part of them have been authorized by Congress. These items are all considered meritorious and urgent for the safety of shipping and have often been requested by navigators and maritime interests.

Vessels.

Forty-six lighthouse tenders have been in commission during the fiscal year. These have steamed a total of approximately 469,000 nautical miles during the fiscal year in their work of supplying light stations, maintaining the buoyage system, transporting construction materials, and carrying the officers and employees of the Service to their stations or on inspection duty.

The following number of tenders were in service on June 30 of the years specified, omitting vessels not having regular crews and those less than 50 feet in length: 1910, 51; 1911, 46; 1912, 45; 1913, 44; 1914, 45; 1915, 46. On June 30, 1915, 40 tenders were in actual service, 1 was laid up, and 5 were undergoing repairs.

The following table shows the cost in detail of maintaining the large and medium size tenders, 37 vessels in all, including every

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item for which direct outlay has been made, showing the miles steamed and the cost per mile. It should be noted in connection with this table that the vessels are operated under dissimilar conditions. Coal costs more in Hawaii than at Norfolk, and the same is true of other matters. The table does not show interest charges or depreciation (except so far as this last may be covered by repairs and improvements, which are included), nor is there any charge for insurance. It includes vessels which operate on the Atlantic and Pacific Oceans and the Gulf and their adjacent waters. The limits of the respective districts whose numbers are given will be found on pages 586 to 588.

The vessels classed as large tenders, except the *Sunflower*, are 190 feet over all, 30 feet beam, and have a maximum draft of about 13 feet, with a corresponding displacement tonnage of 1,053. The *Sunflower* is 174 feet over all, 31 feet beam, and has a maximum draft of about 12 feet, with corresponding displacement tonnage of 986.

The vessels classed as medium tenders vary in length over all from 179 to 105 feet, in beam from 30 to 20 feet, in maximum draft from 12 to 6½ feet, and in maximum displacement tonnage from 975 to 233.

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Cost of Maintaining Tenders in the Lighthouse Service, Fiscal Year 1915.

District.	Name of tender.	Pay officers and crew.	Subsistence.	Fuel.	Supplies.	Other expenses.	Total maintenance.	Repairs and improvements.					Total cost of tender.	Miles steamed.	Cost per mile.	
								Hull, etc.	Boilers, etc.	Moorings.	Boats.	Total.			Maintenance.	Total.
	LARGE TENDERS.															
1	Hibiscus	$17,714	$5,404	$9,020	$2,553	$610	$35,301	$649	$1,173	$3	$43	$1,868	$37,169	13,366	$2.64	$2.78
2	Anemone	18,813	6,133	8,998	3,349	142	37,435	858	1,871	.....	20	2,149	39,584	14,114	2.65	2.80
3	Tulip	19,823	6,135	6,945	3,587	36	36,526	2,784	1,096	77	62	4,020	40,546	16,483	2.22	2.46
5	Orchid	18,384	5,743	5,161	2,639	46	31,973	4,138	3,543	288	148	[a]8,117	40,090	14,373	2.22	2.79
6	Cypress	18,594	6,026	9,787	3,781	50	38,238	2,803	1,181	37	48	4,069	42,307	20,285	1.89	2.09
8	Sunflower	18,605	5,901	8,240	2,467	396	35,609	1,048	1,140	.....	39	2,227	37,836	12,895	2.76	2.93
16	Kukui	22,930	6,166	10,624	6,432	159	46,331	6,234	4,948	.....	523	11,705	58,036	7,547	6.14	7.69
17	Manzanita	22,297	5,796	8,454	2,866	6	39,419	1,106	745	.....	90	1,941	41,360	13,087	3.01	3.11
18	Sequoia	22,590	5,874	10,095	2,866	693	42,118	1,125	1,487	117	.....	2,729	44,847	10,744	3.98	4.17
	Total (9)	179,770	53,178	77,324	30,540	2,138	342,950	20,745	16,584	522	973	38,825	381,775	122,894	2.79	3.11
	Average	19,974	5,909	8,592	3,393	238	38,106	2,305	1,843	58	108	4,314	42,419	13,655	.....	.....
	MEDIUM TENDERS.															
1	Zizania	14,750	4,785	7,072	2,524	720	29,851	1,000	2,472	37	512	4,021	33,872	9,240	3.23	3.67
	Lilac	16,076	5,194	5,868	2,182	508	29,828	1,285	1,024	.....	96	2,305	32,133	[b]12,259	2.43	2.62
2	Azalea	14,954	4,845	3,829	2,857	234	26,717	909	400	18	160	1,487	28,204	11,514	2.32	2.45
	Mayflower	16,516	5,067	5,903	2,133	301	29,919	7,088	2,161	.....	76	9,325	39,244	9,471	3.16	4.14
3	Gardenia	9,120	3,163	1,398	2,263	5	15,948	676	324	.....	13	1,003	16,951	8,728	1.83	1.94
	John Rodgers	11,908	3,978	3,295	1,629	49	20,859	987	244	.....	438	1,669	22,528	7,868	2.87	3.10
	Larkspur	16,794	5,382	6,277	2,503	4	30,960	509	573	.....	4	1,086	32,046	13,687	2.26	2.34
	Mistletoe	11,164	3,737	2,351	1,558	58	18,868	1,278	129	13	126	1,545	20,413	7,692	2.45	2.65
	Pansy	10,899	3,060	160	1,164	2	14,685	4,775	6,012	.....	.....	10,787	25,472	18	.....	.....
4	Iris	14,155	4,218	4,208	3,322	299	26,202	959	2,201	.....	.....	3,093	29,295	11,873	2.21	2.47
5	Holly	12,006	3,941	2,771	1,943	5	20,667	465	362	208	41	1,075	21,742	9,955	2.08	2.18

[a] Includes repairs made in third district.

[b] Includes 14 days in eighth district.

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Cost of Maintaining Tenders in the Lighthouse Service, Fiscal Year 1915—Continued.

District.	Name of tender.	Pay officers and crew.	Subsistence.	Fuel.	Supplies.	Other expenses.	Total maintenance.	Repairs and improvements.					Total cost of tender.	Miles steamed.	Cost per mile.	
								Hull, etc.	Boilers, etc.	Moorings.	Boats.	Total.			Maintenance.	Total.
	MEDIUM TENDERS—contd.															
	Ivy	$16,162	$5,126	[a] $5,325	$3,622	$178	$30,414	$3,101	$2,230	$116	$1,093	$6,540	$36,954	10,419	$2.92	$3.55
	Jessamine	11,929	3,825	2,483	1,854	60	20,150	2,710	350	42	261	3,363	23,513	8,062	2.50	2.92
	Laurel [b]	1,235	378	39	1,102	9	2,762	8	.....	12	95	115	2,877	385	7.17	7.47
	Maple	17,411	5,478	4,057	2,542	137	29,625	2,239	470	114	283	3,106	32,731	13,397	2.21	2.44
6	Mangrove	17,341	5,736	6,636	3,247	28	32,988	2,515	2,176	.....	22	4,713	37,701	14,170	2.33	2.66
7	Arbutus	15,479	4,918	6,248	2,628	454	29,727	2,765	89	.....	4	[c] 2,858	32,585	9,590	3.11	3.41
8	Magnolia	15,075	4,821	6,037	2,799	409	29,141	1,898	2,996	.....	67	4,961	34,102	10,872	2.68	3.14
	Camellia	10,593	3,352	2,789	1,404	326	18,464	489	749	.....	33	1,271	19,735	4,999	3.69	3.95
9	Myrtle	13,666	4,228	4,619	1,682	753	24,948	226	.....	.....	16	242	25,190	8,177	3.05	3.08
10	Crocus	16,523	5,153	4,387	3,351	1,221	30,635	4,323	1,617	.....	142	6,082	36,717	7,884	3.88	4.66
11	Amaranth	14,825	4,621	6,590	4,254	249	30,539	3,646	285	.....	75	4,006	34,545	10,341	2.95	3.34
	Aspen	9,061	2,828	2,555	1,459	335	16,238	2,214	306	.....	88	2,608	18,846	7,880	2.06	2.39
	Marigold	14,762	4,564	3,661	2,079	5	25,071	296	350	.....	25	671	25,742	11,823	2.12	2.18
12	Hyacinth	14,936	4,578	5,663	1,349	184	26,710	1,586	1,826	.....	48	3,460	30,170	10,030	2.66	3.01
	Sumac	17,044	5,379	6,317	3,288	365	32,393	1,184	1,188	7	369	2,748	35,141	11,638	2.78	3.02
16	Fern [d]	1,120	817	.....	554	46	2,537	.....	.....	.....	.....	.....	2,537	25	.....	.....
17	Heather	19,246	5,227	4,965	1,861	92	31,391	8,670	2,857	.....	.....	11,527	42,918	8,078	3.89	5.31
18	Madrono	19,180	5,213	8,707	2,827	688	36,615	34	104	3	203	344	36,959	9,760	3.75	3.79
19	Columbine	21,747	6,486	12,048	2,865	75	43,221	5,243	3,023	6	28	8,300	51,521	13,139	3.28	3.92
	Total (30)	415,077	130,098	136,258	68,845	7,799	758,073	62,976	36,508	576	4,851	104,311	862,384	272,334	2.71	3.06
	Average [e]	14,740	4,604	4,865	2,399	277	26,885	2,249	1,304	20	148	3,721	30,606	9,718	.....	.....

[a] Includes $158 for fuel, ninth district.
[b] Put in commission May 21, 1915.
[c] Includes repairs in eighth district.
[d] Put in commission June 25, 1915.
[e] Average of 28 tenders only.

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Contract was awarded May 4, 1915, for the construction of the first-class seagoing lighthouse tender *Cedar*, already mentioned, for service in Alaska. The contract calls for completion in May, 1916. Weekly reports of the vessel's progress are made to me by the officer representing the Department at the builder's yard.

The medium-draft tender *Laurel*, for service in the fifth lighthouse district (coasts of Maryland, Virginia, and part of North Carolina, including Chesapeake Bay), was completed during the fiscal year, and went into commission May 21, 1915.

The small tender *Fern*, for service in the inside waters of the sixteenth lighthouse district (Alaska), was launched on February 6, 1915, and completed during the fiscal year, proceeding to her station of duty on July 1, 1915.

Contract was awarded on November 6, 1914, for the medium-draft tender *Rose* for service in the bays and sounds of the seventeenth lighthouse district (coasts of Oregon and Washington, including Puget Sound). Work on the vessel was in progress at the close of the fiscal year.

With the increase in the number of aids to navigation and the deterioration of older vessels it will probably be necessary to construct on an average one or two new tenders each year. Estimate has been submitted for a new lighthouse tender to replace the present worn-out tender *Gardenia*, or for general service as may be found most desirable, at a cost of $150,000.

Radio apparatus was designed and manufactured by the Bureau of Standards, with special reference to the particular duties of the Lighthouse Service, for the tenders *Columbine*, *Cypress*, *Orchid*, *Manzanita*, and *Sequoia*. It is intended to equip tenders with such apparatus as fast as possible. Installation was made on the *Columbine* and *Cypress*, but deferred on the other vessels owing to insufficiency of funds in the appropriation entitled "Salaries, lighthouse vessels."

The condition of this appropriation also necessitated the laying up of the tender *Lilac* until such time as more funds may be available.

During the fiscal year the following long voyages were made by lighthouse tenders, in connection with necessary transfers incident to the work of the Service: *Myrtle*, from New York to San Juan, P. R.; *Ivy*, from San Juan to Portsmouth, Va.; *Kukui*, from Honolulu, Hawaii, to Ketchikan, Alaska, via San Francisco and Seattle; and *Columbine*, from Ketchikan to Honolulu, by the same

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route. In all cases the vessels were commanded by masters in the Lighthouse Service, and the transfer made without special incident.

New light vessels *No. 96* and *No. 98* were completed during the fiscal year. The former was assigned to station at Poe Reef, Lake Huron, Mich., in place of *No. 59*, condemned and sold, and the latter to station at Buffalo Entrance, Lake Erie, N. Y., in place of *No. 82*, lost in the storm of November, 1913. (See p. 115 of 1914 report.)

Contracts were awarded on March 6, 1915, for the construction of second-class light vessels *No. 101* and *No. 102*. *No. 101* is intended for general relief duty on the Atlantic coast and *No. 102* for station at Southwest Pass Entrance to Mississippi River, La. Good progress had been made by the builder up to the close of the fiscal year.

Plans are in preparation for the construction of light vessels *No. 99* and *No. 100*. One of these is intended for Nantucket Shoals, and it is my intention, in which the officers of the Lighthouse Service fully concur, that she shall embody the latest word that science and experience can say respecting the construction of light vessels. It is hoped, with the concurrence of the Secretary of Agriculture, to equip her for continued use as a weather-observation station, and possibly to provide that she may be used for other scientific purposes. It is my special desire that this vessel shall be in a sense a scientific outpost of the United States regularly contributing not only to the safety but to the knowledge of mankind.

Two lighthouses of special interest are now being constructed, noteworthy by the distance which separates them while under the control of one service and by the peculiar conditions in each case. One is on the stormy coast of Alaska, the other in the tropical waters of the Caribbean Sea.

The lighthouse for Cape St. Elias, Alaska, is being constructed on an almost inaccessible island which has long been a menace to navigation. The square tower stands on a shelf about 50 feet above water and will support a lantern whose focal plane will be 90 feet above the sea level. The illuminating apparatus consists of a three-mantle lamp of 180,000 candlepower, visible 15¼ nautical miles distant. There will be a fog signal consisting of a 6-inch automatic compressed-air siren, in duplicate, each with a trumpet with a two-way mouth. The characteristic of the light is a double white flash every 20 seconds. That of the fog signal is a double blast of 4 seconds each every minute.

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The lighthouse on Navassa Rock, lying between Cuba and Haiti, is of an entirely different type. It is a reinforced concrete round tower over 150 feet high, standing on the top of a lofty rock island so that the focal plane of the lens will be 402 feet above water and will be visible 27 nautical miles. It lies in the path of vessels from New York and other eastern ports to the Panama Canal and will safeguard a passage largely used by navigators. The light will have 56,000 candlepower and will have as a characteristic a double white flash every 30 seconds.

Cooperation.

In accordance with the established custom of the Service, every effort has been continued to consult the needs of maritime interests and to cooperate effectively with other branches of the Government in matters relating to the work of the Lighthouse Service.

Through cooperation with the passenger steamer lines on Long Island Sound, Conn. and N. Y., regulation of steamer traffic was secured by establishing eastbound and westbound lanes of travel, the Service providing a special gas and whistling buoy, also a bell buoy, to assist in this work. These arrangements were put in effect during the fall of 1914, and in the opinion of navigators have been satisfactory in reducing the possibility of collision in the vicinity, particularly during fog.

The naval construction division has not only designed and prepared specifications for the new steamship *Cedar*, the finest vessel yet designed for lighthouse work in this country, but has also cooperated with the officers of the Coast and Geodetic Survey in designing and preparing plans and specifications for the new steamship *Surveyor*, intended for use in the survey of Alaskan waters, and has since the fiscal year closed designed and prepared the plans for the new steamer *Halcyon* for the Bureau of Fisheries.

The general depot of the Lighthouse Service at Tompkinsville, Staten Island, N. Y., has been of material assistance to the other marine services of the Department, being especially helpful in connection with the preparation of the Coast Survey steamer *Isis* for her work. The spirit shown by the officers and employees of the Lighthouse Service in thus cooperating to assist the other maritime bureaus of the Department has been admirable.

By Executive order of the President, three lighthouse reservations in waters adjacent to Puget Sound, Wash., were set apart

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as refuges for native birds under the supervision of the Department of Agriculture.

Under the authority granted by the act of March 3, 1915, arrangements were made with the Forest Service for the reforestation of certain lighthouse reservations on the Great Lakes, where conditions are favorable for the growth of timber to be used by the Lighthouse Service for spar buoys and other purposes.

Arrangements were made with the Public Health Service for the care and treatment of employees of the Lighthouse Service at marine hospitals and relief stations, upon the same terms as exist for the Army and Navy, under suitable regulations. Arrangements for the administration of vaccination against typhoid fever and smallpox to employees of the Lighthouse Service were also made with the Public Health Service. Sanitary inspections of various stations and vessels were made by officers of the Public Health Service during the year.

Cooperation with the United States Engineer officers in charge of river improvements in the river districts has been continued with success.

Cooperation was had during the year with practically all maritime branches of the Government, particularly the Navy Department, in the prompt reporting of all information affecting aids to navigation.

Legislation Enacted Affecting the Lighthouse Service.

The following is a summary of special legislation affecting the Lighthouse Service, other than appropriations, enacted during the fiscal year 1915:

The following works were authorized by the act of March 3, 1915, but no appropriations have as yet been made to carry out these works: Light at Dog Island, Me., $3,500; improvements at Woods Hole depot, Mass., $50,000; improving aids, Hudson River, N. Y., $100,000; improving aids, Sandy Hook, N. J., $20,000; improving aids, Delaware River, Pa. and Del., $80,000; improving aids, St. Johns River below Jacksonville, Fla., $66,000; additional aids, Florida Reefs, Fla., $75,000; improving aids, Mississippi River below New Orleans, La., $50,000; small tender and barge, eighth district, Texas and Louisiana, $20,000; light and fog signal, Conneaut, Ohio, $63,500; improving aids, Toledo Harbor, Ohio, $15,000; improving aids, Fighting Island Channel, Detroit River, Mich., $25,000; light and fog signal, Kellett Bluff, Henry Island,

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Wash., $40,000; improving aids, entrance to Coquille River, Oreg., $6,000; light and fog signal, Point Vincente, Cal., $80,000; aids to navigation, Pearl Harbor, Hawaii, $80,000.

The act of August 22, 1914, authorized the transfer from the Interior Department of approximately 206 acres of land on the Queniult Indian Reservation, near Cape Elizabeth, Wash., for lighthouse purposes.

The act of March 3, 1915, granted authority for the following purposes:

The use of the unexpended balance of the appropriation of $200,000 heretofore made for two tenders for general service for the construction of additional tenders for general service.

The transfer of a portion of the Tawas lighthouse reservation, Mich., to the Secretary of the Treasury for purposes of the Coast Guard.

The establishment of post-lantern lights and other aids to navigation on Lakes Okechobee and Hicpochee and connecting waterways across the State of Florida and on the Apalachicola River and Chipola cut-off.

Leave of absence for per diem employees who have served 12 consecutive months, under rules prescribed by the Secretary of Commerce.

Cooperation between the Lighthouse Service and the Forest Service in the management of forest land on lighthouse reservations.

Authorizing chief clerks in offices of lighthouse inspectors and persons designated by them to administer oaths to travel accounts or other expenses against the United States, and to administer oaths of office to employees of the Lighthouse Service.

The penalties provided by law for obstruction to or interference with any aid to navigation maintained by the Lighthouse Service are made applicable with equal force and effect to any private aid to navigation lawfully maintained under the private-aids act.

In connection with the work proposed at Woods Hole an explanation should be made.

This depot is well located on the Little Harbor, which is protected in all weathers, but there is not sufficient depth for tenders and deep-draft lightships to reach the dock. In September, 1915, I personally examined this site. The tender *Anemone* (the only one now on station) draws 13½ feet. The water is but 12 feet deep. Therefore the land and buildings owned by the Govern-

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ment are in large part useless. For this reason a portion of a dock has to be rented in New Bedford, and a portion of the fisheries dock in the Great Harbor at Woods Hole has been used. Thus three separate stations are required in place of one, merely for lack of dredging the Little Harbor. This dredging would pay 10 per cent annually in cash saved on its estimated cost. Items of this saving are: Fifteen days' time annually wasted by the *Anemone* at a cost of $100 a day going needlessly back and forth to New Bedford, also the additional cost of water, of which 40,000 gallons per month are used by the *Anemone*, the price being 25 cents per thousand gallons in Woods Hole and $1 per thousand gallons in New Bedford. Furthermore, all supplies to be carried by the tender to the various stations have now to be transported in small boats to and from the station to the fisheries dock or to the tender. The rental of a dock at New Bedford costs $150 per year. The painting and scaling of buoys, which should be done at the station, has now to be done upon the tender. This painting can not be done on shore as it should be done because the tender can not get in to land them and they are too large to be handled in small boats. This takes the equivalent of 30 days' time of the vessel, costing $100 a day for maintenance, used in painting the buoys and scraping them, when this work should be done upon the dock, as it is elsewhere, at a cost of $2 per day. Furthermore, at Woods Hole, Great Harbor freezes in winter and Little Harbor never freezes. In addition, the work of replacing aids has to be delayed by the additional time necessary to go to New Bedford and back. This means that many important aids to navigation which could be replaced on the same day if the tender could get them at Woods Hole require two days or more for replacing under existing conditions.

It is recommended that the channel and basin around the wharf be dredged to a depth of 17 feet at low water. It is also recommended that a brick storehouse 35 feet by 80 feet, two stories high, with a half-pitch roof, be built to replace the present wooden one, which is not adapted to the work and not large enough to accommodate the stock on hand.

This is a case where valuable Government property, ample for the purpose and well located, is largely left unused while at a wasteful cost other property is hired and still other borrowed and the work done with a maximum of inconvenience and inefficiency.

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Duties of the Lighthouse Inspectors, and Their Inadequate Salaries (Omitting River Districts, Where the Inspectors are Army Engineers).

The act of June 17, 1910, provides that "a lighthouse inspector shall be assigned in charge of each district," and that "the lighthouse inspectors shall each receive a salary of $2,400 per annum, except the inspector of the third district, whose salary shall be $3,600 per annum."

Duties of inspector.—The "Regulations for the United States Lighthouse Service," prescribed in accordance with the act of June 17, 1910, charge the lighthouse inspector with the following duties:

The inspector is charged with the supervision of all the work of the district in which he is assigned to duty, and he is responsible under the Commissioner for its efficient and economical administration.

He is responsible for the proper management of the light stations, fog-signal stations, light vessels, relief light vessels, lighthouse tenders, and depots; for keeping upon their stations in proper condition all floating aids to navigation; for the maintenance, repair, and operation of all lighthouse craft permanently or temporarily in the district; for the construction of new aids or additions to aids; for the repair, cleanliness, and efficient condition of all aids to navigation and other property in the district; for keeping ready for service at the shortest notice all spare or relief moorings, buoys, buoy appendages, and relief light vessels; for the distribution of supplies; for the efficiency of the personnel; for the approval of vouchers and accounts covering the disbursement of funds as may be authorized on account of the Lighthouse Service; and for such other duties as are involved in the proper conduct of the district or as may be from time to time assigned to him.

In carrying out these duties the inspector is to exercise a constant and watchful supervision over all district affairs, as well as over the officers and men in the service, so as to maintain the district in a high state of efficiency. He shall keep advised of the needs of navigation as respects aids to navigation in his district.

Responsibilities and work of inspectors.—

Government property, average value *per district* (estimated)	$3,000,000
Vessels, average number per district	7
General coast line, average length per district (miles)	1,000
Aids to navigation per district, average	740
Employees per district, average	280
Annual disbursements, average per district	$304,000

Qualifications of lighthouse inspectors.—Technical knowledge of work of the Lighthouse Service.

Business ability for economical and efficient handling of work.

Vigilance for protection of safety of navigation.

Engineering knowledge and experience, including practically all branches of engineering.

Nautical knowledge and experience.

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Ability to act on independent initiative and responsibility, on account of distance from headquarters (average 1,300 miles), and necessity for immediate action in emergencies.

Ability to act and cooperate with representative citizens, local officers, and other Government officers, in the cities and districts in which stationed, in furtherance of the needs of navigation.

Efficient supervision of a personnel scattered along 1,000 miles of coast (average length of districts).

Comparison of salaries per annum.—

Lighthouse inspectors (except third district), each	$2,400
Naval officer and Army Engineer officer (part of time) replaced by each lighthouse inspector, average pay and allowance per district	5,000
Assistant engineers, War Department, under Engineer officers and not charged with independent responsibility, average in 16 cities	3,300
Captains in Coast Guard (also retirement pension)	4,000
Superintendents, Coast Guard (formerly Life-Saving Service), including longevity pay (also retirement pension)	3,000
Supervising inspectors, Steamboat-Inspection Service	3,000
Assistants, Coast and Geodetic Survey, 12 officers receive from	$2,500 to 4,000

It is not believed that any of the above officers in other important branches of the Government service are charged with any greater responsibilities, or require any higher degree or greater variety of qualifications, than the lighthouse inspectors.

I do not believe the people of the United States, when these facts are brought to their attention or that of their representatives, will be willing to continue the marked injustice which this statement plainly shows. Here are technical men, intrusted with property of great value and with the supervision of great areas, making large expenditures and bearing heavy responsibilities, who are distinctly underpaid for the work they do. I am personally acquainted with every member of this force. They are loyal public servants and are entitled not to a more generous, for the word "generous" would be sadly out of place in this connection, but to a more just compensation for the valuable services they render. Our estimates for the coming fiscal year have accordingly been made upon the basis of a moderate advance in compensation.

Saving of Life and Property.

During the fiscal year 1915 services in saving of life and property were rendered and acts of heroism performed by employees of the Lighthouse Service on vessels or at stations on 143 occasions, a list of which follows:

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SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1915.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
1st.....	Tender Hibiscus.....	Schooner Harriet C. Whitehead.	Pulled vessel off Ram Island Ledge, Me.
	J. Burke, keeper, Cape Neddick Light Station, Me.	Unknown man.....	Saved man from probable drowning; furnished him with clothing and shelter.
	E. Reed, keeper, Whitehead Light Station, Me.	Motor boat.....	Recovered boat adrift near station.
	J. W. Jellison, keeper, Tennant Harbor Light Station, Me.	Motor boats.....	Towed 2 disabled boats to their moorings.
	Tender Hibiscus.....	Motor boat.....	Towed to port disabled boat with 2 men on board.
	Tender Zizania.....	Launch.....	Rescued launch, with 2 men aboard, caught in ice.
	Tender Hibiscus.....	Schooner C.W.Dexter.	Towed into harbor schooner found in dangerous position with rudder and 1 anchor and chain gone.
2d.....	H. C. Towle, keeper, The Graves Light Station, Mass.	Motor dory and motor boat.	Picked up disabled dory with motor boat in tow at East Point, Nahant, and towed to Bass Point; heavy sea.
	E. C. Mott, assistant keeper, Deer Island Light Station, Mass.	The Morning Star; F. McAlpine, owner.	Rescued 2 men from burning motor boat; furnished food, dry clothing, and lodging for the night.
	J. E. Barrus, keeper, and E. H. Hopkins, assistant keeper, Cape Poge Light Station, Mass.	Power yacht Lanagante.	Assisted in working yacht off bar.
	Tender Anemone.....	Four-masted schooner Geo. F. Scannell, of New York.	Towed to channel schooner anchored in dangerous position, with distress signals up.
	Light Vessel No. 73, Mass....	Power boat; Frederic Nickerson, owner.	Rescued disabled boat and owner.
	Tender Anemone.....	Tug Henry Maurer, with tow.	Towed to Hyannis wharf disabled tug anchored with mud scow off Point Gammon.
	G. I. Cameron, first assistant keeper, and E. Mueller, second assistant keeper, The Graves Light Station, Mass.	.....	Furnished food and shelter for night to 2 officers and 6 sailors from ship who were unable to return on account of heavy wind.
	A. A. Howard, keeper, Stage Harbor Light Station, Mass.	.....	Saved horse from sinking in quicksand and water.
	E. C. Hadley, keeper, Bakers Island Light Station, Mass.	Motor boat.....	Furnished food to 2 Italian fishermen; also put engine in working condition.
	Tender Anemone.....	U. S. S. Celtic	Attempted to pull stranded steamer from shoals; unsuccessful.
	H. C. Towle, keeper, The Graves Light Station, Mass.	Motor dory.....	Towed to Lynn a disabled boat drifting to sea with fisherman aboard.
	J. B. McCabe, keeper, and E. C. Mott, assistant keeper, Deer Island Light Station, Mass.	.....do.....	Rescued fisherman in disabled boat.

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SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1915—Continued.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
2d	J. E. Barrus, keeper, and E. H. Hopkins, assistant keeper, Cape Poge Light Station, Mass.	Three-masted schooner Roger Drury.	Assisted schooner, which had struck 2½ miles south of station.
	Light Vessel No. 47, Mass....	Dories from schooner Washakie.	Assisted and supplied food to 6 men adrift in dories from schooner.
	Light Vessel No. 73, Mass....	Dory from schooner Washakie.	Assisted and supplied food to 2 men adrift in dory from schooner.
3d	Ram Island Reef Light Vessel No. 23, Conn.	Power boat; D. Chartier, owner.	Went to assistance and towed disabled boat to safety.
	A. Daunt, master, Bartlett Reef Light Vessel No. 13, Conn., and C. J. Murray, boatbuilder, general depot.	Barney Marsden.....	Rescued helpless man who had fallen off dock.
	W. F. Hill, keeper, Isle La Motte Light Station, Vt.	Motor boat.....	Towed ashore disabled boat, containing 3 persons.
	E. M. Usinger, keeper, Stratford Shoal Light Station, N. Y.	.....do.....	Rescued disabled boat; brought 3 men and 2 women to station; took care of occupants overnight.
	J. Smith, keeper, Duck Island Light, Conn.	Schooner Nettleton; Capt. Lamborn, owner.	Assisted in floating vessel ashore on Duck Island and taking boat to Saybrook.
	J. C. Bouley, keeper, Gull Rocks Light Station, R. I.	Boat from U. S. training station.	Took to place of safety, after 2 hours' work, boat drifting to sea loaded with sand and containing an exhausted man.
	A. G. Baldwin, keeper, Bridgeport Harbor Light Station, Conn.	C. A. Strat.....	Rescued from drowning in Long Island Sound.
	J. Petterson, keeper, Southwest Ledge Light Station, Conn., and G. Lepol, laborer, general depot.	Power boat.....	Towed disabled boat and 3 men to safety; rough sea and strong wind.
	W. J. Murray, keeper, Little Gull Island Light Station, N. Y.	Schooner Andrew Nebinger.	Assisted schooner stranded on reef; helped to place anchors.
	W. F. Petzolt, assistant keeper, Stratford Point Light Station, Conn.	Motor boat Hale.....	Took to safety disabled boat containing 2 boys.
	G. Ehrhardt, keeper, and J. Hamilton, assistant keeper, Long Beach Bar Light, Station, N. Y.	Motor boat Kitty.....	Picked up abandoned boat; turned it over to civil authorities.
	J. B. Murdock, keeper, Rondout Light Station, N. Y.	Exhausted swimmer..	Assisted exhausted swimmer carried out of his course.
	L. P. Brown, keeper, Cold Spring Harbor Light Station, N. Y.	Open launch.....	Rescued and took ashore disabled launch and 4 occupants.
	Do.....	Canoe.....	Rescued 2 young men from filled canoe during heavy storm, and gave them supper, bed, and breakfast.

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SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1915—Continued.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
3d.....	W. L. Tutty, keeper, and A. Herne, assistant keeper, New Haven Light Station, Conn.	Motor boat: A. P. Ives and J. H. Burton, owners.	Rescued disabled motor boat and took care of occupants overnight.
	Tender Tulip.....	Tug Thomas O'Brien..	Assisted and towed disabled tug to Gravesend Bay.
	E. E. Gildersleeve, keeper, Saybrook (Lynde Point) Light Station, Conn.	Power boat.....	Assisted ashore 2 occupants of boats caught in ice; cared for them overnight and assisted in repairing boat.
	T. J. Murray, keeper, Esopus Meadows Light Station, N. Y.	Ice boat.....	Assisted ashore 2 men and 1 woman whose boat had broken through ice; supplied their needs at station.
	E. E. Gildersleeve, keeper, Saybrook (Lynde Point) Light Station, Conn.	Disabled boat, Capt. J. Mulhaley.	Saved and brought ashore boat, with broken rudder, caught in ice; took care of occupants.
	Cornfield Point Light Vessel No. 48, Conn.	Power boat.....	Towed disabled boat, with 2 occupants, to light vessel; repaired engine.
	W. F. Rhodes, keeper, and V. H. Stanton, assistant keeper, Romer Shoal Light Station, N. Y.	Canoe.....	Rescued 2 men and canoe caught in storm off Romer Shoal and capsized.
	W. H. H. Lake, jr., keeper, Shinnecock Bay Light Station, N. Y.	Boat.....	Assisted boat, with woman occupant, off of shoal.
	L. P. Brown, keeper, Cold Spring Harbor Light Station, N. Y.	Open dory with sail; W. Hill, owner.	Went to assistance of 5 men in disabled boat, supplied oars and towed boat to Oyster Bay.
	J. J. Barnes, keeper, North Dumpling Light Station, N. Y.	Power boat.....	Pulled ashore boat and 2 occupants stranded ashore in strong wind before much damage done.
	J. A. Murdock, keeper, Rondout Light Station, N. Y.	Motor boat Natalie, J. H. Flannery, N. Y.	Assisted in raising sunken boat.
4th.....	W. Spear, keeper, Deep Water Point Range Front Light Station, N. J.	Drowned boy.....	Recovered body of boy drowned near station.
	H. C. Wingate, keeper, Delaware Breakwater Range Front Light Station, Del.	Drowning man.....	Rescued from probable drowning man fallen overboard from passing steamer.
	C. J. Murphy, engineer of Tender Iris.	.....do.....	Saved man from drowning.
	H. C. Wingate, keeper, and H. P. Marshall, first assistant keeper, Delaware Breakwater Range Front Light Station, Del.	Motor boat.....	Rescued 4 men drifting out to sea in disabled boat.
	G. A. Holston, laborer in charge, Lewes Lighthouse Depot, Del.	.....	Made 28-mile trip to sea to bring ashore fireman of Fenwick Island Shoal Light Vessel.
5th.....	C. E. Respess, keeper, and E. Davis, assistant keeper, Windmill Point Light Station, Va.	Gasoline launch.....	Assisted occupants of disabled launch.

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SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1915—Continued.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
5th	W. L. Rebbel, clerk, office of lighthouse inspector, fifth district.	J. W. Walsh, clerk, fifth inspector's office.	Attempted rescue of Clerk Walsh from drowning.
	M. Hudgins, keeper, and J. M. Ellis, first assistant keeper, Smith Point Light Station, Va.	Motor boat.....	Assisted 2 men when motor had become disabled.
	R. H. Bertram, master, Relief Light Vessel No. 2.	Power yacht Phalarope.	Assisted leaking yacht.
	J. T. Twiford, assistant keeper, Long Shoal Light Station, N. C.	Power boat Robena, Capt. S. Spencer.	Assisted disabled boat.
	T. H. Baum, keeper, Long Shoal Light Station, N. C.	Small sloop.....	Assisted occupants when sloop went aground.
	A. J. English, keeper, Harbor Island Bar Light Station, N. C.	Power boat Viola.....	Assisted disabled United States mail boat.
	L. H. Staubly, keeper, Blakistone Island Light Station, Md.	Sloop Volunteer.....	Assisted sloop in leaking and sinking condition.
	G. M. Willis, sr., keeper, Point No Point Light Station, Md.	W. Yeatman and child.	Rescued assistant keeper and child from drowning.
	U. B. Jennett, second officer, tender Jessamine.	Gasoline freighter Margaret Atkinson of Baltimore, Md.	Towed loaded disabled freighter into Annapolis.
	C. B. Gray, keeper, Greenbury Point Shoal Light Station, Md.	Canoe.....	Assisted 2 oystermen in capsized canoe.
	W. F. Outten, first officer, tender Woodbine.	.....do.....	Rescued 2 men from drifting canoe.
	J. Hanson, master, Relief Light Vessel No. 72.	S. S. Washingtonian..	Rescued 39 men from steamship rammed off Fenwick Island, Del.
	T. H. Baum, keeper, and J. T. Twiford, assistant keeper, Long Shoal Light Station, N. C.	Schooner Hamlet of Hatteras, N. C.	Assisted schooner run aground on Long Shoal, N. C.
	B. Wroldsen, quartermaster, tender Jessamine.	C. Gregory and C. Sawyer.	Rescued men from drowning after boat capsized in heavy squall.
	A. J. Davidson, first officer, and J. Whitehurst, second assistant engineer, Woodbine.	Tender Woodbine.....	Rendered prompt assistance in saving tender from fire.
	J. R. Monteiro, master, tender Ivy.	Schooners Mary S. Ewing and Julia and Anne.	Attempted to rescue schooner Mary S. Ewing in a gale; assisted schooner Julia and Anne.
	A. M. Thistel, master, Cape Charles Light Vessel No. 49.	Light Vessel No. 49...	Kept vessel on station, submarine signal and whistle in operation during heavy storm of Apr. 3, 1915.
	F. J. Pusey, mate, in charge of Light Vessel No. 97.	Motor boat.....	Assisted 4 occupants of disabled motor boat.

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SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1915—Continued.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
5th.....	E. Meekins, jr., keeper, and W. H. Etheridge, second assistant keeper, Bodie Island Light Station, N. C.	Mail launch Swastika.	Assisted disabled launch with 7 passengers aboard.
	E. L. Thomas, keeper, Tangier Sound Light Station, Va.	Motor boat Bernice L.	Rescued 3 men from boat sunk off station.
	W. R. Schoenfelder, keeper, Fishing Battery Light Station, Md.	Man overboard.....	Assisted man who fell overboard from dredge near station.
	A. J. English, keeper, and C. R. Austin, assistant keeper, Harbor Island Bar Light Station, N. C.	Schooner Davis, Davis, N. C.	Assisted schooner grounded on Harbor Island Bar, N. C.
	W. F. Outten, master, tender Laurel.	Schooner Alert, Seaford, Del., Capt. Winfield Scott.	Assisted schooner flying distress signals; towed her into Annapolis.
6th.....	Tender Mangrove, Master E. C. Tull, commanding.	Schooner Wm. H. Yerkes; Dunn Elliot Co., owners.	Brought ashore master and 10 of crew of wrecked schooner.
	Do.....	U. S. Engineers dredge Savannah.	Pulled dredge off shoals, St. Simon Sound, Ga.
	J. Robertson, keeper, and M. B. Wilder, assistant keeper, Little Cumberland Island Light Station, Ga.	Parties searching for bodies of crew of Rambler, wrecked near station.	Gave shelter and otherwise assisted searching parties.
	J. Lindquist, keeper, and W. Lindquist, assistant keeper, Mosquito Inlet Light Station, Fla.	Yacht Niagara of New York; J. S. Simmons, owner.	Took owner and family off yacht ashore in breakers; worked off yacht and took it to station.
	H. S. Svendsen, keeper, South Channel Range, etc., Light Station, S. C.	Launch; name and owner unknown.	Saved launch ashore on breakwater at Sullivans Island, S. C.
	L. H. Bringloe, keeper, G. N. Jackson, first assistant keeper, and A. E. Burn, second assistant keeper, Charleston Light Station, S. C.	Launch.....	Assisted to station and took care of 4 fishermen; repaired launch.
	Do.....	Various small boats...	Furnished food and clothing to 30 fishermen washed ashore on Morris Island, S. C.
	C. P. Honeywell, keeper, J. B. Butler, first assistant keeper, and O. F. Quarterman, second assistant keeper, Cape Canaveral Light Station, Fla.	Steamer Loando; owner unknown.	Assisted ashore officers and crew of wrecked steamer; cared for 3 of crew at station.
7th.....	T. M. Kelly, keeper, J. P. Roberts, jr., first assistant keeper, and T. L. Kelly, second assistant keeper, Rebecca Shoal Light Station, Fla.	Steamers Nordvahlen and Veenbergen.	Assisted steamers ashore near station.

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SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1915—Continued.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
7th	C. H. Gardner, keeper, Cedar Keys Light Station and Turning Point Light, Fla.	Rowboat.....	Rescued from drifting boat man apparently insane.
	H. P. Weatherford, keeper, and R. Palmer, second assistant keeper, Fowey Rocks Light Station.	Yacht May Belle.....	Rescued 5 passengers from yacht which sank immediately after rescue.
	Tender Arbutus.....	American steamer Standard.	Helped disabled steamer to raise anchor.
	C. G. Johnson, keeper, and H. A. Pierce, first assistant keeper, Sand Key Light Station, Fla.	Launch.....	Helped off rocks launch with 4 men aboard.
8th	Tender Camellia.....	Racing sloop Stranger; owner unknown.	Righted and towed to port boat capsized during squall.
	Mrs. M. R. Norvell, keeper, Port Pontchartrain Light Station, La.	Man on steamer Hanover.	Brought to station man taken suddenly ill, and cared for him until death.
	Tender Sunflower.....	Schooner Maud B. Krumm; owner unknown.	Furnished provisions.
	G. R. Smith, keeper, and L. R. Smith, assistant keeper, Red Fish Bar Cut Light Station, Tex.	Launch.....	Assisted disabled launch; cared for the 4 occupants overnight.
	W. W. Bayly, keeper, Chandeleur Light Station, La.	Schooner Madeline; owner unknown.	Furnished shelter to woman and child taken from schooner which had gone ashore.
9th	Launch of Tender Myrtle...	Ferry launch Dicosha.	Towed to safety wrecked launch with passengers.
	J. M. Agostini, keeper, Catano Range and Anegado Shoal Range Lights, P. R.	Launch.....	Assisted disabled launch.
	E. T. O'Melia, former chief clerk.	Canoe.....	Saved man from capsized canoe.
10th	J. C. Belden, keeper, Rock Island Light Station, N. Y.	Large power boat.....	Rescued disabled boat with 5 men on board.
	Do.....	Launch Indunno of Gananoque, Ontario.	Repaired disabled launch towed to station.
	Do.....	Launch.....	Assisted stranded launch into deep water; furnished bed and breakfast for 2 occupants.
	B. A. Dissett, first assistant keeper, Toledo Harbor Light Station, Ohio.	.....do.....	Towed ashore launch with 8 men aboard, disabled and in dangerous position.
	C. Duggan, keeper, South Bass Island Light Station, Ohio.	Steam barge Isabel Boyce.	Assisted in landing and cared for crew of 8 from burning barge.
	R. C. Graves, keeper, Galloo Island Light Station, N. Y.	Small power boat.....	Towed launch 4 miles for supply of gasoline.
	F. Ritter, keeper, Sandusky Bay Inner Range Light Station, Ohio.	Two launches.....	Towed to safety disabled launch with 1 occupant, and motor boat with 4 occupants.

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SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1915—Continued.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
10th.....	C. H. Tucker, keeper, Oswego Light Station, N. Y.	Rowboat.....	Brought to station 2 women rescued from drowning.
	H. E. Walts, keeper, Sunken Rock Light Station, N. Y.	Skiff.....	Rescued man in skiff from being run down by steamer.
11th.....	R. Carlson, keeper, Whitefish Point Light Station, Mich.	Steamer Ora Endress.	Rescued 11 men from capsized vessel; provided food and clothing at station.
	W. G. Marshall, keeper, and F. McFall, assistant keeper, Windmill Point Light Station, Mich.	Launch.....	Pulled launch at sea wall out of reach of heavy sea.
	J. Metivier, keeper, and L. Hudak, third assistant keeper, Spectacle Reef Light Station, Mich.	Motor boat Effie.....	Towed disabled launch to shore.
12th.....	E. C. Johnson, assistant keeper, Calumet Pierhead Light Station, Ill.	Sloop Rascal.....	Assisted drifting sloop with 3 men on board.
	J. M. Robinson, keeper, and H. Osby, first assistant keeper, Calumet Harbor Light Station, Ill.	Motor boat T. Bradwell.	Assisted disabled motor boat with 6 men aboard.
	S. M. Danielsen, keeper, Chicago Harbor Light Station, Ill.	Gasoline launch The Bug.	Assisted launch, with 1 man aboard, from drifting out into lake.
	G. Fox, second assistant keeper, Chicago Pierhead Range Light Station, Ill.	Drowning man.....	Rescued man who fell from dock near station.
	F. A. Drew, keeper, and G. W. Drew, assistant keeper, Green Island Light Station, Wis.	Gasoline launch Alice W.	Towed disabled launch to safety.
	Do.....	Motor boat.....	Assisted 4 men in leaky boat.
	Do.....	.....do.....	Brought to safety 2 men and 1 woman in disabled boat.
	F. A. Drew, keeper, Green Island Light Station, Wis.	Gasoline launch Wesley L.	Assisted grounded launch.
	G. H. Sheridan, keeper, Kalamazoo Light Station, Mich.	Open gasoline launch Quindess; J. D. Annable, owner.	Rescued 3 women and 4 men; brought launch to safety.
	Do.....	Gasoline launch Lady Ramor; F. Sholtz, owner.	Assisted launch, with 3 women and 3 men aboard, ashore during gale.
	A. C. Erickson, keeper, Little Traverse Light Station, Mich.	Motor boat.....	Towed to safety disabled launch with 2 men aboard.
	Do.....	Gasoline launch patrol boat No. 4; State of Michigan, owner.	Towed disabled launch into dock.
	J. Napelzinski, keeper, Manitowoc Breakwater Light Station, Wis.	Dredge and scows; Greiling Bros., owners.	Assisted in floating grounded dredge and scows.

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SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1915—Continued.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
12th	T. Robinson, keeper, Muskegon Pierhead Range Light Station, Mich.	Motor boat Bohemian Girl.	Assisted disabled motor boat with 2 boys aboard.
	J. M. Marshall, keeper, and J. H. Sullivan, third assistant keeper, White Shoal Light Station, Mich., and W. Barnum, first assistant keeper, Old Mackinac Point Light Station, Mich.	Launch Ida L.....	Saved launch during gale.
	G. M. S. Hansen, keeper, Sheboygan Pierhead Light Station, Wis.	Rowboat..... ...	Brought ashore 2 men and capsized boat.
	L. Bourissau, keeper, W. F. Green, first assistant keeper, O. E. Dame, second assistant keeper, and F. L. Moore, third assistant keeper, South Fox Island Light Station, Mich.	Motor boat.....	Brought ashore and repaired disabled sloop; cared for 1 man, 1 woman, 2 children overnight.
	J. Fountain, keeper, and W. Hall, assistant keeper, St. Helena Light Station, Mich.	.....do.....	Assisted 2 men in leaking boat.
	Do.....	.....do.....	Towed disabled launch to safe harbor.
	C. H. Hubbard, master, and crew of tender Sumac.	Steamer Joseph C. Butler.	Assisted steamer; carried into shoal water.
	H. R. Bevry, keeper, J. Lonne, first assistant keeper, and W. H. Nash, second assistant keeper, Wind Point Light Station, Wis.	Motor boat Jeanette N; K. A. Nelson, owner.	Saved launch in rough sea.
	A. Van Velzen, first assistant keeper, Chicago Pierhead Light Station, Ill.	Drowning man.....	Saved from drowning man who fell from pier.
16th	E. Pecor, first assistant keeper, and D. O. Kinyon, second assistant keeper, Tree Point Light Station, Alaska.	Launch Cora; C. Nelson, owner.	Furnished oil, gasoline, and provisions to enable boat and occupants to reach Ketchikan.
	N. S. Douglas, keeper, and G. Tibbets, assistant keeper, Lincoln Rock Fog Signal Station, Alaska.	C. Sands, trapper.....	Gave provisions to trapper, whose food had become exhausted.
	Do.....	R. S. Mowin and C. Gorden.	Cared for party, hungry and nearly frozen, who had lost their launch.
	W. J. Pearson, first assistant keeper; W. A. Phillips, second assistant keeper, and W. Rosenberg, substitute keeper, Cape Sarichef Light Station, Alaska.	Coast Guard Service S. S. Manning landing boat.	Cared for late keeper of station during illness; attempted to rescue persons when landing boat capsized.

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SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1915—Continued.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
17th.....	O. H. Wayson, assistant keeper, Smith Island Light Station, Wash.	Motor boat.....	Towed ashore boat with 4 occupants.
	E. A. Brooks, keeper, New Dungeness Light Station, Wash.	Steamer Sioux.....	Assisted steamer and took off passengers.
	Tender Heather, Capt. E. Hammerstrom.	2 fishing boats.....	Convoyed boats to Astoria from Columbia River bar.
	J. M. Coleman, keeper, Tongue Point Lighthouse Depot, Oreg.; O. Hoveden, temporary laborer at depot; and G. Pearson, laborer in charge of lights on Columbia River.	Upturned boat.....	Rescued man clinging to upturned boat.
18th.....	Tender Madrono.....	Navy tug Vigilant....	Towed disabled tug off beach at Goat Island.
	Keepers, Pigeon Point Light Station, Cal.	Gasoline fishing boat; Union Fish Co., owners.	Hauled boat off rocks and transported it to safety.
	Crew of San Francisco Light Vessel No. 70.	U. S. Navy launch Castro.	Rescued man fallen overboard.

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COAST AND GEODETIC SURVEY.

The former Superintendent of this Service, Dr. Otto H. Tittmann, resigned on April 14, 1915, after 48 years of fruitful service in various capacities. Mr. Frank Walley Perkins, who had been Assistant Superintendent for 14 years and had been connected with the Survey 52 years, resigned March 23, 1915. Capt. Robert Lee Faris was promoted to Assistant Superintendent March 8, 1915, after 22 years' service. Dr. E. Lester Jones, theretofore Deputy Commissioner of Fisheries, was appointed Superintendent of the Coast and Geodetic Survey, and was sworn in April 15, 1915.

Old Buildings.

It is an old story to again call attention to the inadequate conditions afforded this Bureau in the buildings at present occupied, which cover 70,000 square feet of floor space, distributed in such a manner that work is difficult and expensive. One of these buildings was built for a hotel, and it is cut up into so many small rooms that the partitions take up much space. Because of this, no division can be properly supervised, with the possible exception of the new printing section. The buildings are 5 and 6 stories high, respectively, with 16 different levels in one and 11 in the other; and without any suitable elevator. They are improperly lighted and are overcrowded. One of the worst features about them is the fact that they are not fireproof, and records that cost millions of dollars and could not be replaced short of the expenditure of other millions of dollars are constantly in danger. To remodel these old structures would avail nothing; rebuilding is the only means of providing permanent relief. The efficiency of the Bureau is daily disturbed by the incommodious office conditions and by the inconvenience and loss of time involved in communication between widely separated portions of the buildings.

The foregoing statement can not be overemphasized. The further expenditure of money on these old buildings would be an actual waste, for while they are made by care to look well to the casual caller they can not be made to work well. The accompanying illustration shows the floor, basement, and roof levels of

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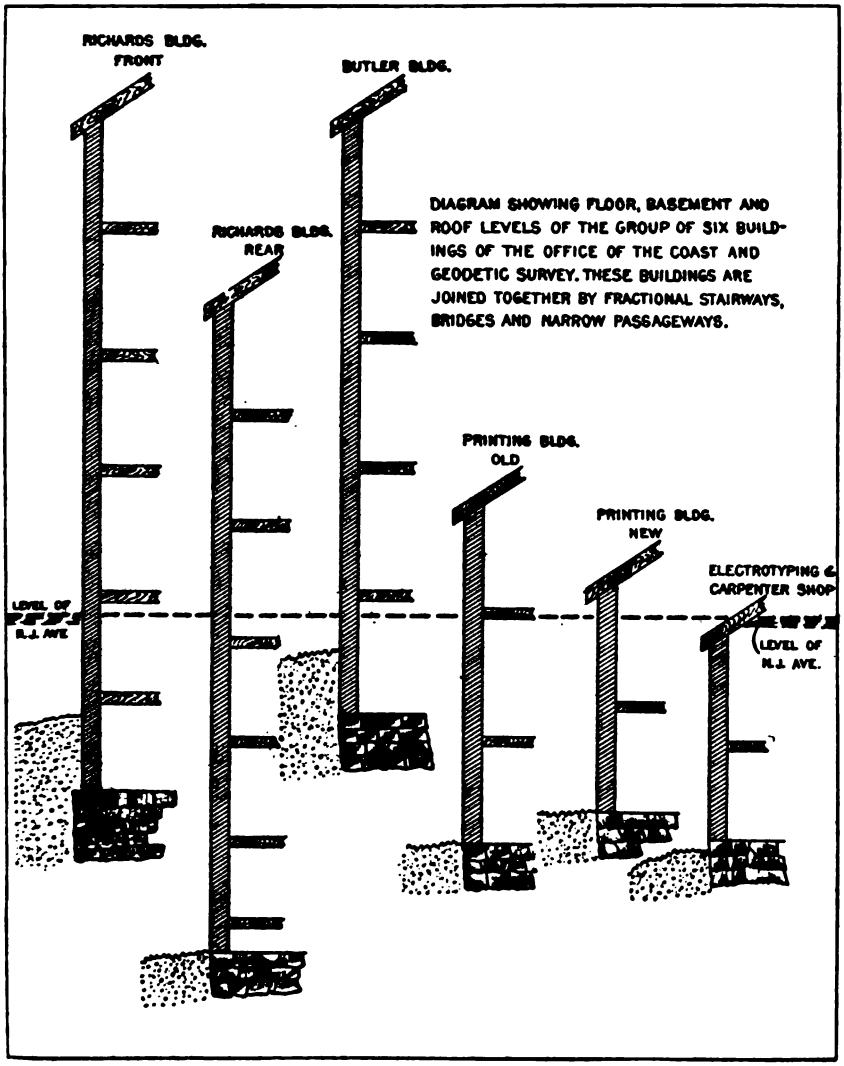
the group of six buildings which house this service. No sane factory manager would attempt to run any kind of a productive plant in such premises longer than necessary to replace them. Were there such a function as a public incendiary, these buildings are among the first that should receive his official attention. They are heated


RICHARDS BLDG. FRONT
BUTLER BLDG.
RICHARDS BLDG. REAR
DIAGRAM SHOWING FLOOR, BASEMENT AND ROOF LEVELS OF THE GROUP OF SIX BUILDINGS OF THE OFFICE OF THE COAST AND GEODETIC SURVEY. THESE BUILDINGS ARE JOINED TOGETHER BY FRACTIONAL STAIRWAYS, BRIDGES AND NARROW PASSAGEWAYS.
PRINTING BLDG. OLD
PRINTING BLDG. NEW
ELECTROTYPING & CARPENTER SHOP
LEVEL OF N.J. AVE.
LEVEL OF N.J. AVE.

by antiquated low-pressure boilers which must either be replaced by new ones at a cost of $2,000 or be again ineffectually repaired at a cost of $1,000. To do this last would be simply to throw away money. The present conditions require the expenditure of $1,400 per annum for coal to heat the Richards Building and force

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the Treasury Department to expend about $1,000 per annum for coal to heat the Butler Building, two-thirds of which the Coast and Geodetic Survey occupies.

The facilities for handling this coal are of a prehistoric type, warranted to cost the most with the least result. The coal is dumped from trucks into bins under the parking at the front of the building. Thence it is taken in wheelbarrows over a tortuous route to the boilers at the rear of the buildings. This is done in the open air, without protection from the weather. There is no place to store coal near the boilers. Meanwhile a branch line from the heating main of the central power and heating plant, from which heat is supplied to all the buildings under the supervision of the Superintendent of the Capitol, runs directly through the buildings occupied by the Coast and Geodetic Survey. Whether this condition is humorous or tragic may be a question. Heat is there in abundance, to be had for tapping a pipe. Meanwhile the ridiculous process now in use goes on because that pipe may not be tapped. One wishes for the ready pen of a humorist to describe this fine example of how things should not be done.

It is recommended that authority be given to tap this heating main to permit the wasteful, ancient boilers now in use to be discarded and to allow the room these fossils occupy to be turned to some useful purpose. This will save the Government $2,460 per annum in addition to the time and labor required for the care of the present boilers. It will also save annoyance from smoke and ashes during operations which ought not to be subjected to such annoyances, and will lessen the danger from fire.

The Coast Survey uses in a portion of the premises occupied by it electric current furnished from the Capitol Building, a practice which began at the time of the Spanish War, before the present power plant for the Capitol was erected. For the rest of the premises it pays a private producer for electric current.

There is an electric main belonging to the Government directly across the street. It is recommended that a connection to this main be permitted in order to save the money now paid to private parties.

With Government heat and light thus near at hand—indeed, in one case passing through the building—while on the other hand separate expense is incurred for both, one wonders what would be said of the practical efficiency of the management under which such things are allowed to continue. However, legislation is required before this condition can be amended.

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Vessels.

I spoke plainly in my report for the last fiscal year of the condition of the vessels of this Service. Congress made an appropriation pursuant to which the fine seagoing yacht *Isis* was purchased in the spring of 1915 to replace the ancient *Endeavor* in the work of the Coast Survey in Atlantic waters. The *Endeavor* has been condemned and sold. The *Isis* was purchased with her equipment for about one-fourth of her original cost, though in sound condition, and has been for months at work without material change. She is a vessel of which any service might be proud, and as a working tool will do more and better work in a month than her predecessor could do in a year. She will be engaged in offshore work on the Atlantic coast.

A contract has been let, as already noted, for the construction of a new steamer known as the *Surveyor* for the Pacific coast and Alaska service. She will replace the *McArthur* of ancient memory, which has been ordered condemned and sold. This is a good beginning, but it leaves the Service in bad shape till more is done. The old *Gedney*, a veteran of 40 years' service, known to be unseaworthy, has also been ordered to be condemned and sold. The *Patterson* will no longer be used in exposed waters. She was lightly built 33 years ago and underpowered.

The necessary withdrawal of the *McArthur* before the *Surveyor* can take her place and the condemnation of the *Gedney* will leave the Service during the working season of 1916 short of two vessels—such as they were. We must try to keep the *Patterson* in use two years more in the protected waters of southeast Alaska. The *Explorer* also shows structural weakness and must be kept out of harm's way. So far as the urgent work which is needed off the coasts of Washington, Oregon, California, and Alaska is concerned, therefore, the service is practically short four vessels. Until the *Surveyor* is in commission and other similar ships are built, we can not hope to do any of this work, for there is not now a vessel in the Pacific coast service sufficiently seaworthy to expose her to the risk of work in the open sea. Therefore, our estimates for the coming fiscal year include the cost of two new ships urgently required for the work necessary for the charting of the unsurveyed and exposed offshore portions of the coasts of our Pacific Northwest and Alaska.

An economy is possible by making funds for ship construction immediately available which may be lost if the use of same is with-

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held until the opening of the fiscal year. This economy may take the form both of time and money. In such conditions as now exist the lapse of a month in placing contracts may mean an increase in price of some thousands of dollars and the delay of a number of months in the completion of the ship. To illustrate: Inquiry was made of a prominent shipbuilding company whether they would duplicate for the Coast and Geodetic Survey the ships they were building for the Coast Guard. The answer was that they could not consider so doing, for the Coast Guard vessels had been taken at a time when work was slack and it was necessary to keep their organization together. A very considerable increase in price was therefore demanded.

A table follows showing the vessels in the Coast and Geodetic Survey Service on September 20, 1915.

Atlantic coast, Gulf of Mexico, Porto Rico, and Panama:
- *Isis* (new).
- *Bache.*
- *Hydrographer.*
- *Matchless* (schooner).

Pacific coast, Alaska, and Hawaiian Islands:
- *Patterson* (weak).
- *Explorer* (weak).
- *Gedney* (condemned).
- *McArthur* (condemned).
- *Taku* (large launch).
- *Yukon* (large launch).
- *Cosmos* (launch).

Philippine Islands:
- *Pathfinder.*
- *Fathomer* (owned by Philippine government).
- *Marinduque* (owned by Philippine government).
- *Romblon* (owned by Philippine government).
- *Research* (owned by Philippine government).

Building at Manitowoc Ship Building & Dry Dock Co.:
- *Surveyor.*

The insufficient complement and equipment for our vessels at times seriously disturbs the efficiency of the work. The enlisted men on the Pacific coast (particularly the seamen and firemen) are paid less than any other service, either Government or commercial. Union wages for seamen in the coastwise trade, which control the rates paid in the merchant-marine service, are $45 to $53 per month and found, with double pay for overtime. The Lighthouse Service pays seamen $50 per month and 45 cents rations, excepting Alaska, where the pay is $55 and the rations 60 cents, and in addition furnishes its seamen with oilskins and sea boots. The Coast Guard pays its seamen $44 per month

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and rations of 48 cents per day. The Coast and Geodetic Survey pays its seamen $40 per month and 45 cents rations. The men of this service are furthermore not assured of continuous work throughout the year, as insufficient funds make it possible to retain only the number needed to carry on part of the work.

It is, therefore, extremely difficult when recruiting in the spring to get even moderately good crews, and it is impossible to build up a permanent organization of reliable men experienced in the specialized work which they are called upon to perform, and sufficiently devoted to the service, by reason of permanent association with it, to perform willingly and without protest the extremely arduous work which the exigencies of the service often demand. The crews on the Pacific coast have to be recruited at Seattle at the time of the year when men of the type we seek are in greatest demand by the lumber interests, the canneries, and the fishing fleets, which are then getting ready for their summer work. It is not an exaggeration to say that 70 per cent of the men we get on the Pacific coast come to us as a last resort. We constantly lose time through lack of men trained in the work of the service. The surveying vessel with her appurtenances is a complex and complicated affair, and requires corresponding skill to keep her in condition. Much of this work is such that it can not be done when working in the field, and this is another reason why trained men should be kept on these vessels the year around.

If the "chief of the party," who is the commanding officer of the vessel, is allowed to build up a more or less permanent organization composed of such men as are needed for efficiency, then in due time he can be relied upon to greatly increase the amount of work turned out by his vessel and to reduce the unit costs.

The following table shows the pay of seamen in the Coast and Geodetic Survey, the Lighthouse Service, the Coast Guard, and the merchant marine on both the east and west coasts:

Service.	East coast.		West coast.	
	Pay per month.	Rations per day.	Pay per month.	Rations per day.
Coast and Geodetic Survey	$30.00	$0.45	$40.00	$0.45
Lighthouse Service	35.00	.45	[a] 50.00	[a] .45
Coast Guard	36.00	.45–.51	44.40	[b] .48 up.
Merchant marine	35.00	.50	45.00–53.00	Rations.

[a] Alaska, pay, $55; rations, 60 cents.

[b] Rations at Juneau, 59 cents.

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COMPARISON OF PRESENT MONTHLY RATES OF PAY OF ENLISTED MEN IN COAST AND GEODETIC SURVEY WITH SIMILAR RATINGS IN THE COAST GUARD, BUREAU OF LIGHTHOUSES, AND MERCHANT MARINE.

Rating.	Atlantic coast.				Pacific coast.		
	Coast Survey.	Light-house Service.	Coast Guard.	Merchant marine.	Coast Survey.	Light-house Service.	Coast Guard.
Assistant to engineer, second class	$55.00	.....	$75.00–110.00	$75.00–80.00	$75.00	.....	$75.00–110.00
Assistant to engineer, third class	40.00	$50.00	44.40	75.00–80.00	60.00	.....	.....
Boatswain	65.00	.....	75.00–110.00	.....	75.00	.....	75.00–110.00
Boatswain mate, chief	50.00	.....	75.00–110.00	.....	65.00	.....	75.00–110.00
Boatswain mate, first class	40.00	.....	75.00–110.00	.....	55.00	.....	75.00–110.00
Boatswain mate, second class	35.00	.....	75.00–110.00	.....	50.00	.....	75.00–110.00
Coxswain for power launch	35.00	.....	38.40	.....	45.00	.....	46.80
Quartermaster, first class	40.00	45.00	44.40	.....	50.00	$55.00	54.00
Quartermaster, second class	35.00	45.00	40.80	.....	45.00	55.00	50.40
Quartermaster, third class	35.00	45.00	.....	.....	45.00	55.00	.....
Seamen	30.00	45.00	36.00	35.00–40.00	40.00	55.00	44.40
Seamen, ordinary	25.00	.....	28.80	.....	35.00	.....	38.40
Writer, first class	40.00	.....	.....	.....	50.00	.....	.....
Writer, second class	35.00	.....	.....	.....	45.00	.....	.....
Wireless operator, first class	40.00	.....	68.00	.....	65.00	.....	68.00
Wireless operator, second class	40.00	.....	40.00	.....	45.00	.....	50.00
Mess attendant, first class	20.00	30.00	21.60	.....	35.00	.....	.....
Mess attendant, second class	16.00	.....	18.00	.....	30.00	.....	21.60

It will be noted that seamen are not paid as much as by other departments of the Government service and the merchant marine. To do this will require a material increase in the appropriation "For all necessary employees to man and equip the vessels."

The attached diagram shows relatively the men, ships, and coast line of the British Isles and those of the United States and Alaska.

Geodetic Work.

The question whether the geodetic work in the United States can be done by the individual States must be answered in the negative. This work involves primary triangulation and precise leveling. The former is the process of determining the correct distances between points. The latter is the process of determining exact elevations with reference to the sea.

It is necessary to have both primary triangulation and precise leveling in each State for the framework of State and county boundary surveys, for national and local topographic, drainage,

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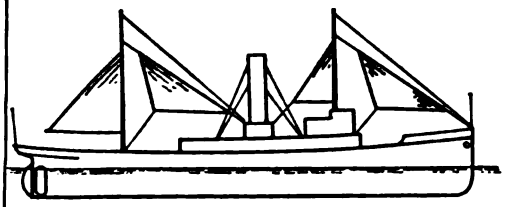
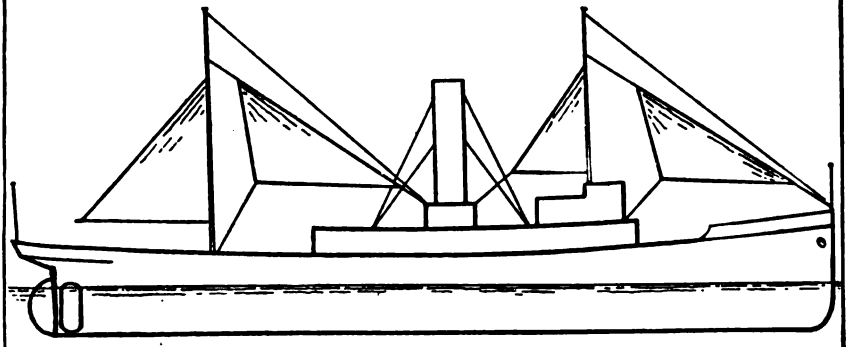
UNITED STATES and ALASKA

BRITISH ISLES

Diagram of Men, Ships and Coast Line of the British Isles, and of the United States and Alaska, showing relative number of surveying officers and men, tonnage of surveying vessels, and the coast line covered by their respective surveying services



UNITED STATES and ALASKA



BRITISH ISLES

Coast line of the United States and Alaska

Coast line of the British Isles

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irrigation, mineral, and other surveys, and for various engineering operations. The necessity for this primary control we must accept as a fact, in view of the experiences of other nations as well as of our own.

The United States is divided into 48 States, some of which are relatively small in area. Each of the long arcs of primary triangulation and each of the lines of precise leveling traverses several States, and it would be difficult, to say the least, to obtain the cooperation at one time and in the same way of all of the States involved in any one arc or line. For example, the transcontinental arc of primary triangulation passes through 14 States; the Texas-California arc crosses 4, and the ninety-eighth meridian arc goes through 6. A similar condition obtains with regard to the long level lines.

Were each State able and willing to do that part of the primary triangulation and precise leveling within its own area, how then could there be a comprehensive scheme for the whole country? It would be absolutely necessary to have a national geodetic association, with each State represented in it, and with a central bureau to direct its operations. If each State worked independently, there would be little or no agreement with the work in adjoining States, and the gaps and overlaps at the boundaries would be a constant source of trouble to surveyors and map makers. Another annoying feature would be the lack of uniformity in the results of the work, as each State would be free to adopt its own standards of accuracy, if there were no supervising bureau. It would require many decades to complete the work, even if executed by the cooperation of all the States, each covering its own territory, and then a central organization would be necessary to adjust the work of the States and obtain from it a comprehensive whole.

Let us consider the experience of Australia. For years each State of that country conducted its independent geodetic surveys, with the result that, at a conference of the surveyors general held in 1912 at Melbourne, a resolution was adopted recommending that the geodetic survey be carried on by the Commonwealth.

The only conclusion possible is that our National Government must complete the general program which is being followed by the United States Coast and Geodetic Survey. This plan is, briefly, that the primary triangulation scheme and the precise level net should be so extended that there will be no place in the

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United States distant more than about 100 miles from a primary triangulation station and from a precise level bench mark.

Whether the National or State Government should execute the control work in the intermediate areas is another problem. Many of these areas will lie wholly within single States and, as far as State and local surveys and engineering works are concerned, the States could properly supplement the fundamental schemes. However, to carry on geodetic work requires a corps of highly trained specialists and an expensive instrumental equipment, besides trained experts to compute and adjust the results. The State engineering departments are not at present equipped for this work. For some time, therefore, after the primary triangulation and precise leveling are completed the National Government must furnish additional control for the lesser surveys and engineering.

Greater New York called for an officer of the Coast and Geodetic Survey to direct the primary triangulation of its area. The Survey cooperated because the results were of value in the revision of charts in the vicinity of New York City. The city of Cincinnati requested the Coast and Geodetic Survey to detail an officer to direct the primary triangulation and precise leveling of that city, but as the Survey could not do this the city employed a former officer of the Coast and Geodetic Survey to take charge of the work. Several years ago the city of Memphis requested the Survey to extend a primary triangulation over its area, and during the past winter Richmond requested the Survey to cooperate with it in making primary triangulation and precise leveling over its area. In the case of Cincinnati, Memphis, and Richmond the problem was not similar to that of New York, as the results would not be of value to the Coast and Geodetic Survey in its charting work. However, in the case of Memphis an arc of primary triangulation was carried to that place, from which the city may be triangulated. This arc is in the general scheme which the Survey proposes to extend over the whole country eventually.

Atlanta, Ga., and Lufkin, a town in Texas, have recently requested that precise leveling bench marks be established by the Coast and Geodetic Survey for the basis of city surveys and maps. This the Survey can not do now for lack of funds.

The National Government spends several millions of dollars annually for surveys and maps of various kinds. The efficiency of this work will be materially aided by having the fundamental

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control extended rapidly. Accurate surveys and maps are national assets and aid materially our industrial development. Primary triangulation and precise leveling are not of immediate value only, for their monuments and bench marks may be used repeatedly for an indefinite time, and in any given area will probably never have to be duplicated. The National Government can well afford to adopt a plan of carrying the fundamental geodetic control to a rapid completion, as only about one and one-quarter million dollars are needed to finish the geodetic work here contemplated. If this work could be done at all by the several States, the field and office work and the overhead charges would no doubt cost several times this amount and the great delays would make the nation the loser by much more than the cost of the work.

The necessity is immediate of having precise levels and primary triangulation extended along the principal rivers in Alaska. This Territory is rapidly developing, and if primary triangulation and precise leveling can be carried into the interior ahead of the detailed surveys much money will be saved.

In addition to the triangulation and leveling in the interior of Alaska, there is needed a triangulation across the Alaska peninsula connecting Cook Inlet and Bristol Bay.

It is recommended that a primary triangulation be carried from Dixon Entrance northward to White Pass at the head of Lynn Canal, Alaska, and also that the triangulation of Puget Sound and other waters between Point Roberts and Tacoma be strengthened. These two pieces of work are portions of an arc of primary triangulation which will connect Alaska with the United States. The Canadian Government is now undertaking a primary triangulation to extend from Dixon Entrance southward to Point Roberts. If the United States will extend the triangulation to White Pass, as mentioned above, it is understood that the Canadian Geodetic Survey will then carry the triangulation from that point down the Yukon River to a connection with the one hundred and forty-first meridian triangulation in the vicinity of Eagle City. The desirability of having all of the triangulation of North America on the North American Datum is apparent to all who have to use the results of triangulation in surveys and maps.

For the purpose of carrying on the triangulation and leveling in the interior of Alaska there should be appropriated, specifically for this object, about $25,000 per annum until the work is completed.

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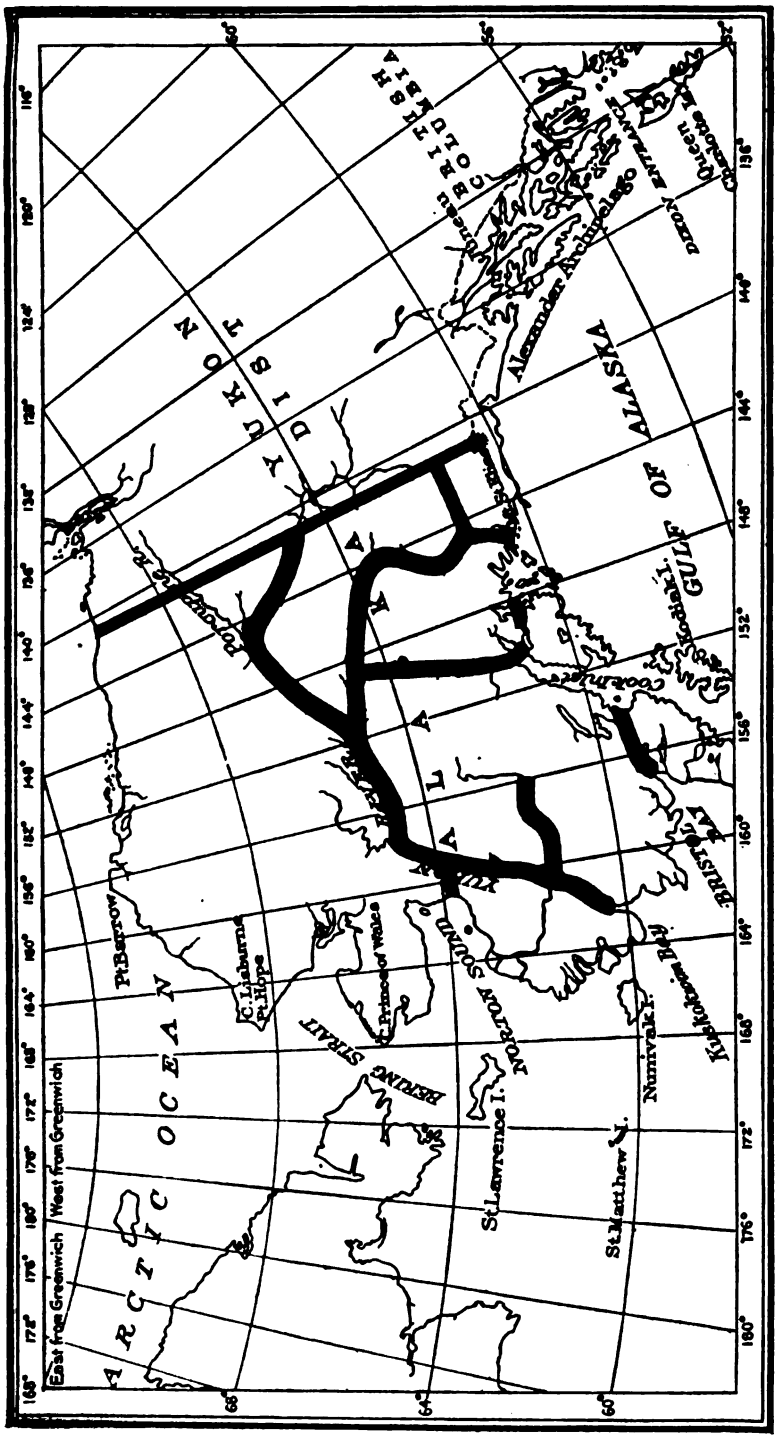

PRIMARY AND SECONDARY TRIANGULATION NEEDED IN ALASKA NOW.
(Work along 141st meridian has been done by Boundary Commission.)

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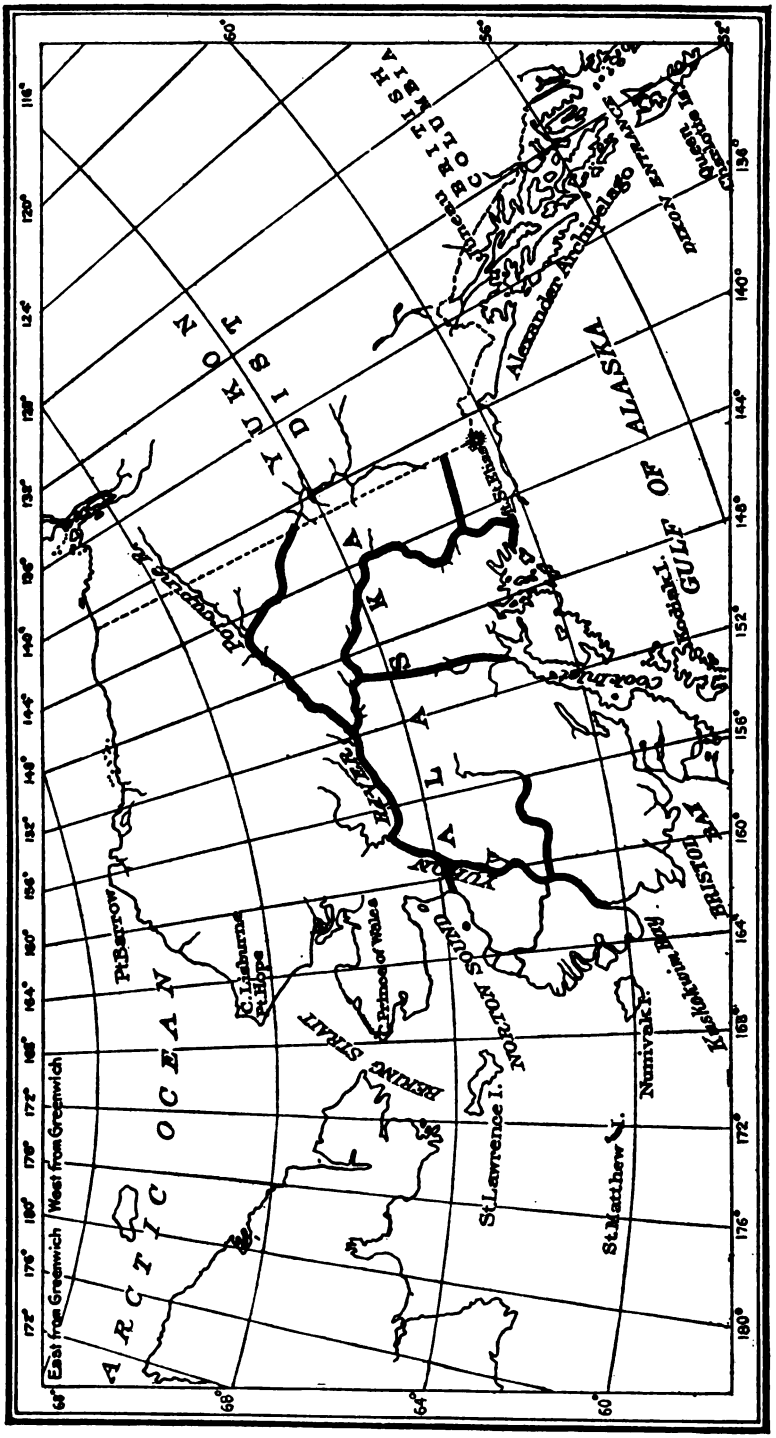

PRECISE LEVELING NEEDED IN ALASKA NOW.

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The item of the appropriation bill, "Party expenses, Pacific coast," should be sufficiently large to permit of $10,000 being used on the triangulation along the coast between Dixon Entrance and White Pass and between Tacoma and Point Roberts; also for the connection between Cook Inlet and Bristol Bay.

There is also needed triangulation revision along the Atlantic coast of the United States and a slight amount on the Gulf coast. The triangulation there is old and many of the points have been destroyed. Such should, in most cases, be reestablished. Until recent years the mark of a triangulation station was not of a permanent character. When a concrete mark is used without something to designate its purpose, it is apt to be destroyed by thoughtless persons who imagine it is a mark for buried treasure. Many important stations have been lost for this reason. Practically all of the stations of the Survey are now marked by an inscribed metal disk set into the concrete or solid rock, which allays any curiosity the visitor may have. Wherever old stations are found along the coasts, they should be re-marked in a modern and substantial manner. About $5,000 as a minimum should be available each year for the revision of triangulation on the Atlantic and Gulf coasts. This fund should be provided for in the item of the appropriation bill entitled "Party expenses, Atlantic coast."

The following statements show the amount of precise leveling and primary triangulation needed in the interior of Alaska.

TRIANGULATION NEEDED IN ALASKA.

	Miles.
Norton Sound to Eagle, via Yukon River	750
Yukon River to Kuskokwim Bay	350
Upper part of Kuskokwim River	250
Across Alaskan Peninsula, Cook Inlet to Bristol Bay	120
Susitna River, Cook Inlet to Fairbanks	300
Cordova to Tanana, along Copper and Tanana Rivers	700
From Copper River to One hundred and forty-first meridian	100
Total	2,570

PRECISE LEVELING NEEDED IN ALASKA.

Norton Sound to Eagle, via Yukon River	800
Yukon River to Kuskokwim Bay	400
Upper part of Kuskokwim River	300
Susitna River, Cook Inlet to Fairbanks	325
Cordova to Tanana, along the Copper and Tanana Rivers	750
Copper River to One hundred and forty-first meridian	110
Total	2,685

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Launches for Inshore Work and Wire Drag.

A vessel for offshore hydrography, which is mapping the bottom of the sea, must be of an ocean-going type, but a vessel for the inshore, and particularly for inside hydrography, should be a smaller craft. The custom has been to provide surveying vessels intended to be used for all kinds of work, with the result of giving the Survey small ships, too large for the inshore work, too small for the offshore work. Our present surveying ships, while at inshore duty, anchor in protected waters and the surveys are made by launches and boats frequently too small for the purpose, while the mother vessel is too large. On offshore work, the ship, being too small for safe ocean navigation, has to wait for good weather in order to run outside, and must drop her work and seek safety when it storms.

The *Isis* and *Bache* do useful offshore work on the Atlantic coast. The *Pathfinder*, in the Philippines, and the new *Surveyor* are the only other vessels of the Coast Survey large and stanch enough for offshore duty. None of them is small enough for economical work inshore. To use them for such work would be like using the crowbar for a toothpick. For wire-drag work neither these ships nor their launches are suitable, and therefore the custom has grown up of hiring at a comparatively high cost the large launches needed for the wire drags. Common sense requires that this unbusinesslike condition be remedied by providing small vessels and launches of such types as the work requires.

A very large proportion of the hydrographic work has to be done close to shore or in protected waters. For this service "one-party vessels," with a total force of 10 men, are more economical than to use a larger steamer. The Survey has now two such vessels in Alaska. Six are required for the necessary work on the Atlantic and Gulf coasts and as many more on the Pacific coast and in Alaska. It is intended to construct one or more of these vessels from the funds that will be asked from Congress for launches.

This fund of $100,000 can be invested in launches for wire-drag work at a 17 per cent return to the Government. In other words, if so expended it would save the Government an annual expenditure now incurred of $17,436. The present outlay for hire of launches would pay for the launches in a comparatively few years. But apart from this, no launches can be hired which are designed for the special work they have to do. The proposed appropriation, therefore, would mean that more work would be done and better done than can be done to-day and that it would actually cost less

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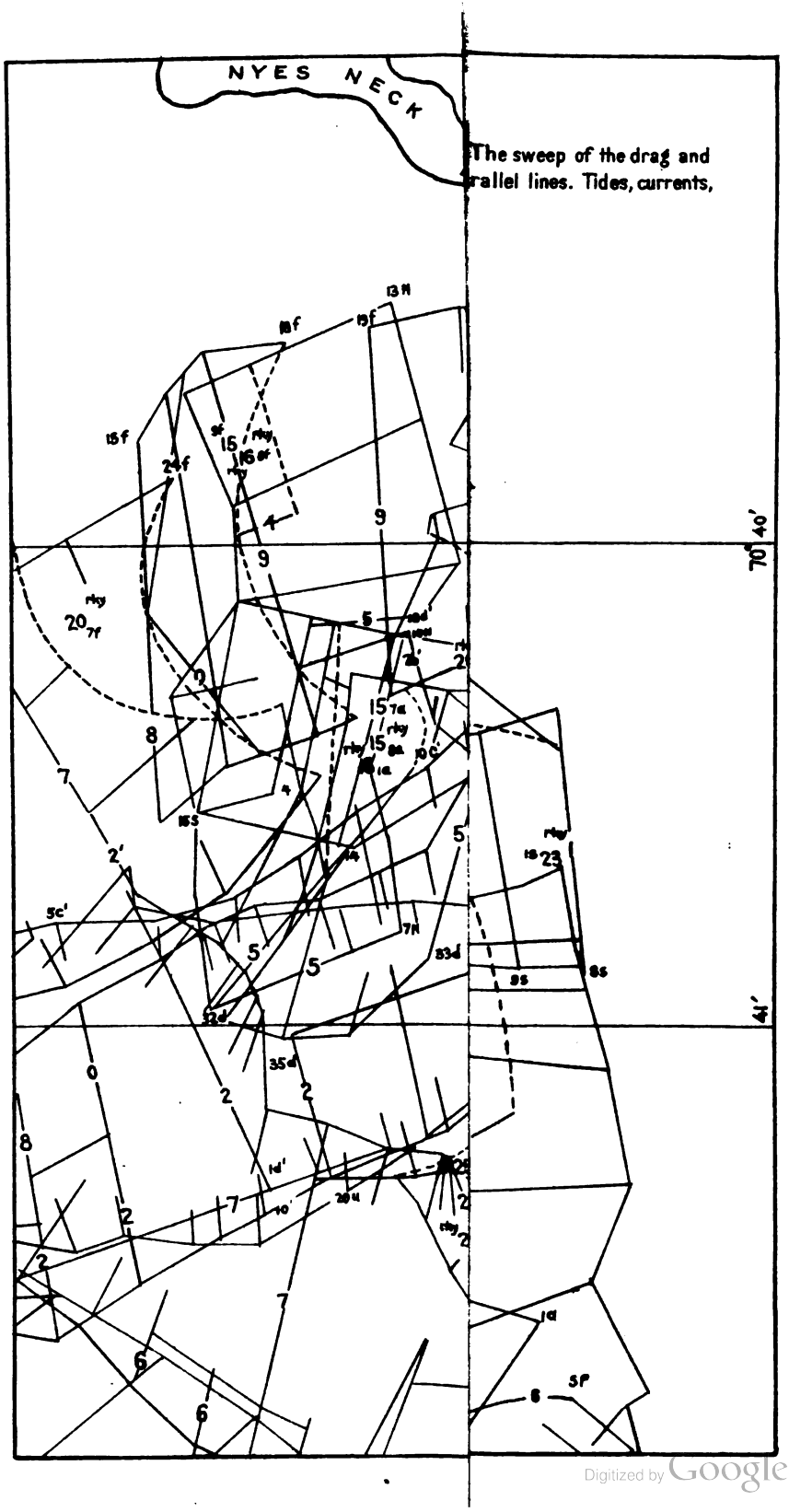

The sweep of the drag and
rallel lines. Tides, currents,

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than it now does. It is a waste of money to charter a boat unsuited for the purpose at a high cost to do the work of a wire-drag party, the expense of which in service is from $200 to $300 per working day, when a vessel can be built designed for the special work which will cost less and do more.

The accompanying section of a wire-drag field sheet shows the intricate nature of the work in the field as well as the plotting of it in the office. The area illustrated has been covered by wire-drag survey, the drag being drawn by the power boats mentioned above. The sweep of the drag and the course it took can be followed on the diagram by observing the many series of parallel lines. The tides, currents, and the action of the wind make it impossible to systematically cover the entire area by a straight parallel course.

Through the wise action of Congress there were in operation during the current fiscal year four wire-drag parties, two in Alaska and two on the Atlantic coast. This is double the number that have ever been before. They have achieved great, not to say startling, results. The average cost for each party is about $20,000 for the six or eight months' season in which they can work out-of-doors, a total of $80,000 for the combined operations. This work is immediately and practically productive. The increasing demands for new hydrographic surveys due to the increased size, draft, and speed of ships, and the development of submersible ships of war, together with the constant changes in depth and in form of bottom arising from the movements of sand on our Atlantic shores, call for the constant making of new surveys and resurveys of the most vital importance to the country. In this work the part played by the wire-drag parties is of great and immediate importance. Its cost per working day during the past fiscal year has been as follows, the different parties being distinguished by the name of the officer in charge:

Officer in charge.	Locality.	Date.	Cost per day.
	Atlantic coast:		
Heck	Portland	June-September, 1914	$333
	Buzzards Bay	October-November, 1914	213
	Key West	January-March, 1915	293
	Boston	May-August, 1915	187
Hawley	Buzzards Bay	June-September, 1914	200
	Cape Cod Bay	May-August, 1915	194
Colbert	Southeast Alaska	May-August, 1915	328
Daniels	do	July-October, 1914	413
		May-August, 1915	268

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The differences in cost in the above table are due to two principal causes:

1. The initial cost includes the first cost of the outfit, a part of which is available for subsequent work.

2. Some variation is due to weather conditions, which affect the number of days available for work.

The use of the wire drag has revolutionized hydrographic surveying. It has long been known that sounding with the lead line was not an infallible means of detecting submerged dangers. This is emphasized by the large number of such dangers which have become known and are shown on the charts only as the result of wrecks that have occurred upon them. It has not been so well known, and only the development of the wire-drag work within a recent period has made it clear, that a large number of submerged dangers may and do exist in much-frequented waters, being unknown and unsuspected merely because by chance no vessel of considerable draft has happened to pass immediately over them. This is, of course, especially true on our rocky shores.

During the past summer several such dangers have been discovered in the waters, many times surveyed, of Massachusetts Bay, and unpleasantly near the port of Boston. One rock with 25 feet of water over it was found where 51 feet were shown by soundings. Another with 21 feet over it was found where 41 feet were shown. A 15-foot bowlder was found not far from Scituate lying between soundings of 26 feet and 28½ feet, which were the least depths indicated in the vicinity. Dangerous, unknown rocks were discovered by the wire drag in the channel leading from the East River into Long Island Sound, but a short distance from New York City and in one of our most frequented waterways.

In Alaska in a short season of three months 21 uncharted submerged rocks, constituting serious dangers to navigation, were discovered in 42 miles of channel. The existence of these had never been suspected. Recently a pinnacle rock with but 15 feet of water over it, of which there was no indication on the published charts, was struck by a vessel in the middle of Whale Passage. It was necessary to issue in August, 1915, a new print of the chart of Boston Harbor showing the changes developed by the use of the wire drag off that port during the summer of 1915.

It is interesting to know that this work has so far developed that in the summer just past drags have been used that are 24,000 feet

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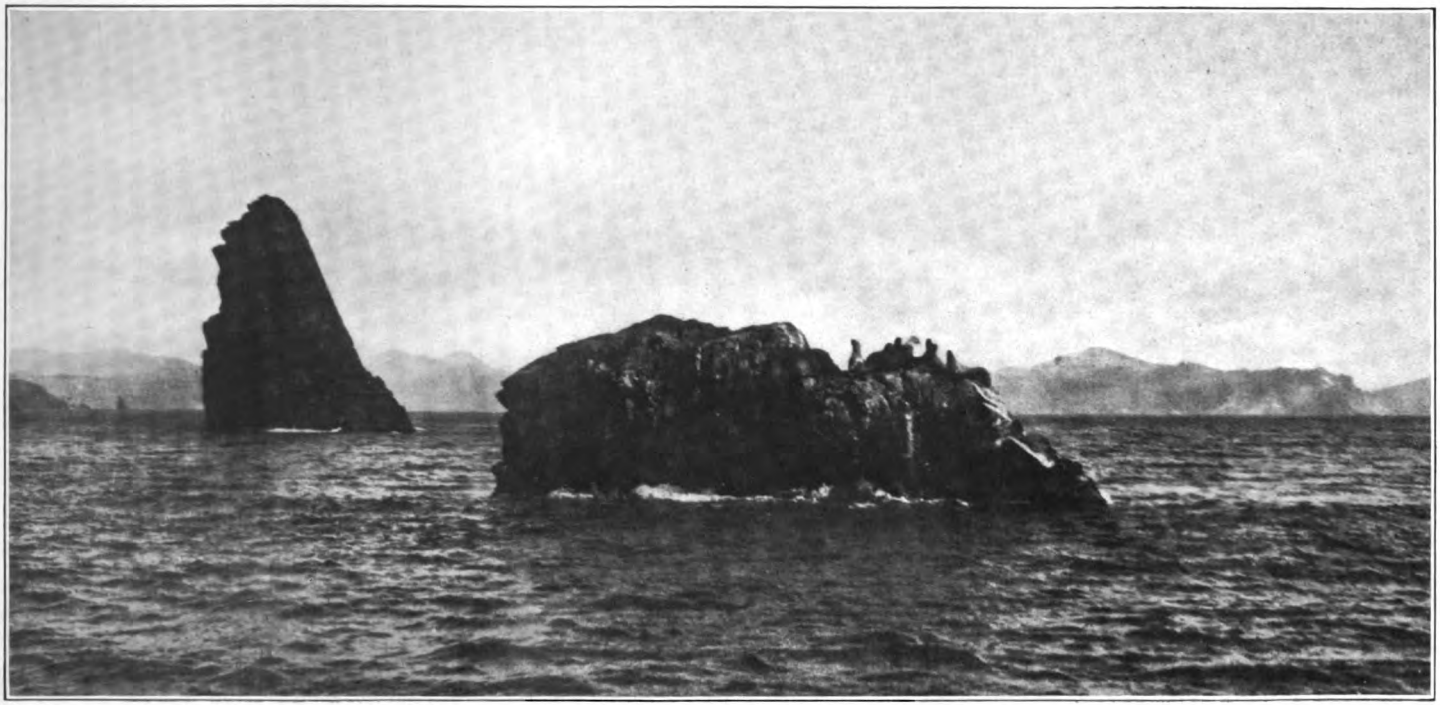

PINNACLE ROCKS ON THE ALASKAN COAST.

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long, by means of which 20 square miles were covered in a single day.

The accompanying illustration shows the nature of the pinnacle rocks on the Alaskan coast.

It should be remembered that the difference in tide is sometimes as great as 32 feet and that a vessel may therefore pass safely more than once over an unknown pinnacle which on another voyage when the tide was low might wreck her. One of the rocks discovered in Alaska is truly a sort of submerged Washington Monument, except that it is taller than the Monument. It rises over 600 feet from the bottom of the channel to within 17 feet of the surface. It is surrounded by deep water on all sides and is now located on our charts where a sounding of 109 fathoms (654 feet) was formerly recorded. The engineer in charge of the wire-drag party says that if the lead struck this pinnacle in making the old survey it probably slipped off into over 600 feet of water immediately alongside. More probably, however, the point of rock lay between two lines of soundings and was missed altogether. The finding of this single pinnacle will more than pay the cost through many years of the entire wire-drag work on all our coasts if it shall prevent a single wreck thereon.

Increase in Office Force Required.

In 1911 the printing of charts required 207,568 impressions. In 1915 there were 304,799 impressions. This means that one-half more work was done. In the past year and in previous years many of the office force had to work overtime to keep up with the increasing demands upon the Service. There are not enough clerks and messengers, and the force in the drawing section and printing office of the chart construction division, and the force in the computing division, are inadequate. Work has necessarily accumulated, because there is not sufficient help to get it out. Computers are needed to make the results of the Survey's work available to the public promptly. The present force can do little toward putting new results in final form for publication. The staff is insufficient to handle the chart material received from all sources. Therefore charts are not issued containing the latest information as promptly as they ought to be. Changes in charts arise from new surveys, from alterations in aids to navigation made by the Lighthouse Service, and from data supplied by the United States engineers. These number in a year approximately 500.

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The growth of the work is shown by the fact that in 1910 the services of 1.7 draftsmen, working continuously every working day in the year, were necessary to keep up. In 1911 this work required 2.5 draftsmen. During 1915, 4.7 draftsmen were engaged, and were not enough.

The accompanying illustration will explain what is meant above by the phrase "putting new results in final form for publication." It shows the chart of New York Harbor, reduced in size, and indicates the number of changes which accumulated during a single year on this chart and the sources from which they came. These different sources and the locations on the chart to which they apply are indicated by the different colors. There were 11 corrections arising from original field sheets showing the work of the Coast and Geodetic Survey itself. There were 65 arising from blue prints indicating the work of the Army engineers. There were 125 from city maps which had to be noted, and there were 52 light and buoy corrections arising from the operations of the Lighthouse Service. Thus on the chart of this one harbor in a single year 253 changes were required, and the time necessary for compiling, drawing, and engraving them was 233 working days.

Men are necessary to reconstruct the charts of southeast Alaska. The present charts were compiled before the triangulation was adjusted and each reported danger or new aid placed brings to light serious discrepancies.

The men in the printing section are underpaid. Their wages are not in accordance with those paid for similar work in other departments of the Government and in commercial houses. The force in the printing section has not been increased in proportion to the output of charts, and the facilities are not adequate for turning out the work promptly.

The clerical force is conspicuously inadequate. The Superintendent has neither clerk nor stenographer. The need of a clerical assistant to act in the capacity of a secretary and stenographer to the Superintendent is a matter that I recommend for immediate consideration. At the present time the Superintendent is greatly handicapped, owing to the fact that he has to call for assistance from those who are rendering customary services to other officials in the same Bureau, and further, owing to the inadequate clerical force, the Department has been appealed to during the last six months, and has at various times supplied a stenographer. It is

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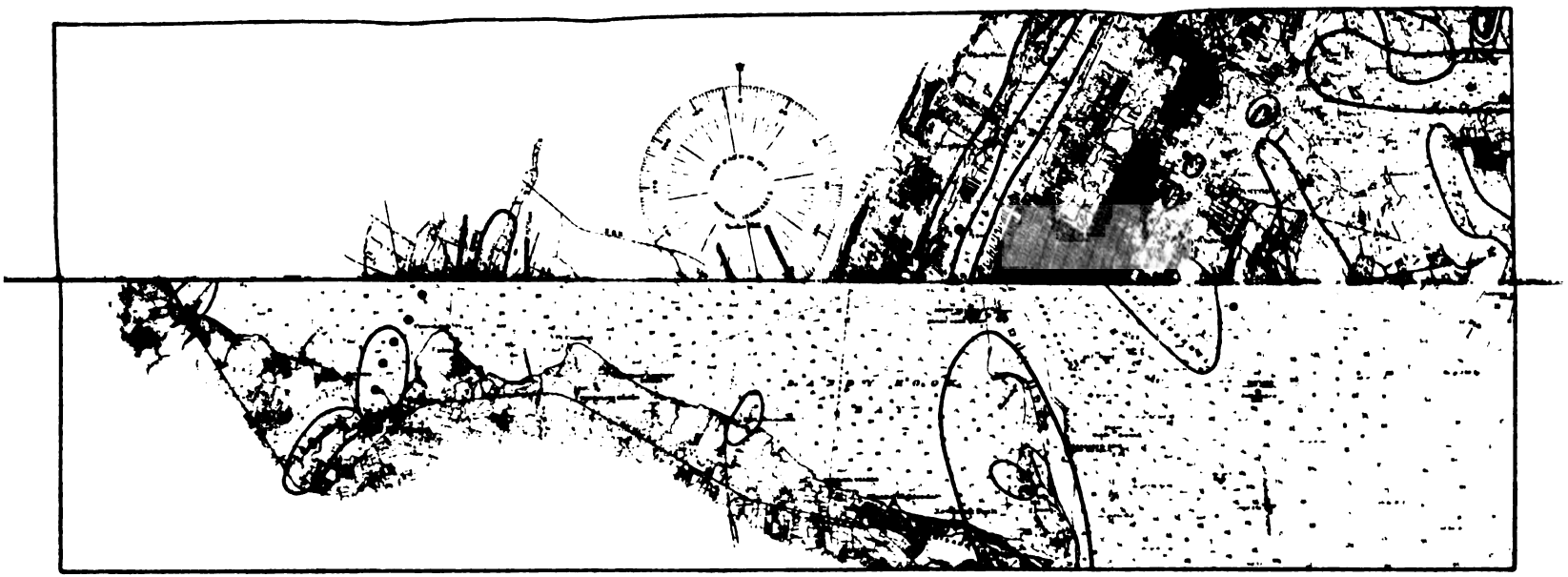

Corrections which have accumulated in
a year to keep this chart up to date.

11 Original field sheets
65 Blueprints, U.S. Engineers
125 City Maps
52 Light and Buoy corrections

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earnestly recommended that a secretary to the Superintendent be provided in the urgent deficiency bill at a salary of $1,800 per annum.

In some divisions it has been found that work has seriously accumulated from the fact that there was not sufficient stenographic help. The Superintendent has appealed to the Department at large for assistance in this respect, and though such has been furnished as far as was possible it has not been sufficient to keep up with the work.

Bureau Printing Facilities.

The results of our surveys reach the navigator and the engineer in the form of charts. Large sums and much labor are spent in collecting and arranging the material for these charts. It is essential that the charts shall show the results of this work in the most perfect form. The final stage in making the chart is the printing of it, and the best press known should be employed to maintain this work at the highest standard. There should be enough presses to make it possible to meet urgent demands promptly. The chart must be distinct and the colors on it must register; that is, they must fit exactly in their assigned places. A very slight fault, hardly noticeable to the layman, in this respect may well mean the loss of a vessel. Where chart paper for printing has to lie for lack of a press for an interval between the several printings it requires, it contracts or expands, and this means faulty register. Faulty register means that a buoy may be shown out of its true place.

With the single press the Service now has this rapid sequence in printing is impossible because of the time necessary to clean up the press to change the color. After the first black printing the press must be cleaned to put on the red color to print the buoys, and after this is done the press must again be cleaned before putting on the tint color. Each cleaning means at least an hour's loss of time while the press lies idle and while the paper shrinks.

Modern presses are made which prevent this loss. I therefore urge the provision by Congress of a two-color, offset press, by means of which the two most important impressions required on our charts can be done at one printing and with much greater accuracy than is at present possible. This will also permit a reduction in the cost of paper used by omitting the high finish which the use of the present press requires that the paper shall

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have. Reference is made to a letter dated April 20, 1915, from the Director of the Bureau of Standards as follows:

DEPARTMENT OF COMMERCE,
BUREAU OF STANDARDS,
Washington, April 20, 1915.

The SECRETARY OF COMMERCE,
Washington, D. C.

DEAR SIR: Answering your letter of April 12, relative to facts bearing on the advisability of using an offset press for printing nautical charts at the Coast and Geodetic Survey, you are advised as follows:

Chart paper of the quality required by the Coast and Geodetic Survey in order to meet the conditions for both copper plate and flat-bed lithograph printing is considered by the paper industry as a paper belonging to a special class having a very restricted demand. Such papers are, therefore, trade specialties, and the experience of this Bureau has clearly shown that even the high-grade mills can not make a satisfactory sheet of chart papers without first making experimental runs, entailing an extra cost to the Government.

The offset press is rapidly superseding the old-style flat-bed lithograph press, and for this reason many mills that formerly produced sized and supercalendered papers for the flat-bed lithograph press are now equipping their mills to manufacture what is known in the trade as offset papers. Chart papers are very little known in the paper trade, whereas offset papers, together with the requirements necessary to produce suitable papers, are receiving a large amount of attention by the paper trade at this time.

Offset papers made from all-chemical wood to all-rag stock are carried in stock by the paper trade at prices ranging from 6 cents to 14 cents per pound, and it is the belief of this Bureau that a suitable paper could be secured by the Coast and Geodetic Survey at a price not to exceed 12 cents to 14 cents. It is the belief of this Bureau that if the Hydrographic Office of the Navy Department would purchase its chart paper in conjunction with the Coast and Geodetic Survey, thereby enabling the mill to make a full run at one time, would result in a lowering of the price to the Government on the special sizes required for chart printing. There may be other bureaus that could also combine with the above in their purchase.

The Bureau desires to call your attention to one point: The offset press so far has not given entire satisfaction on small-scale charts having great detail, or for charts required to show a mass of rock and harbor detail, as the fine detail lines are not as sharp and clear from offset printing as they are when printed from engraved copper plates. For this reason it may always be necessary to have some copper-plate printing, though the number of such charts is relatively very small as compared with the bulk of the charts printed.

You, of course, appreciate the fact that copper-plate printing requires that the paper must be thoroughly moistened with water before printing. This dampening of the paper causes more or less buckling or wrinkling, and distortion is liable to occur while the paper is being printed. The offset press entirely overcomes this trouble, as the paper is printed dry and, moreover, the offset press will show excellent results on papers that have far too rough a surface for either flat-bed lithograph or copper-plate printing.

Respectfully, S. W. STRATTON, *Director.*

It is recommended that the force employed in the Coast Pilot section be reorganized by making them assistants and that the number of assistants be correspondingly increased with a similar decrease

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in the appropriation for offshore soundings, from which appropriation the salaries are now paid. This will add to the efficiency of the service by rendering the ability of the nautical experts in the Coast Pilot section available for all branches of the Survey's work, instead of confining it as now to strictly Coast Pilot work. It will give an opportunity to the younger members of the field force assigned to the Coast Pilot work to learn the work of the Service in other divisions, will eliminate the lump-sum salaries, and provide greater flexibility in the Service generally.

International Geodetic Association.

Congress has for two years failed to appropriate funds for the contribution of this country to the International Geodetic Association. The United States entered into an agreement with other nations under which we are obliged to make our annual contribution to this work. The following letter shows that the United States agreed to continue in the International Geodetic Association for a period of ten years from December 31, 1906:

EMBASSY OF THE UNITED STATES OF AMERICA,
Berlin, November 9, 1905.

M. No. 8004.

The undersigned, ambassador of the United States of America at Berlin, has the honor to inform Monsieur van de Sande Bakhuyzen, permanent secretary of the International Geodetic Association, that the Government of the United States approves of the proposition to continue for a period of ten years after the 31st of December, 1906, without modification, the agreement under which the International Geodetic Association is operating and which will expire at that date.

The undersigned ambassador avails himself of this opportunity to express to Monsieur van de Sande Bakhuyzen the assurance of his distinguished consideration.

CHARLEMAGNE TOWER

Monsieur VAN DE SANDE BAKHUYZEN,
Permanent Secretary of the International Geodetic Association,
Observatory of Leyden, Holland.

The agreement referred to in the letter of Mr. Tower will expire at the end of the calendar year 1916.

In view of the above it is believed that the United States is still a member of the International Geodetic Association, and it is recommended not only that this country be represented by a member of the permanent commission, but that sufficient funds be made available by Congress to meet the contributions covering the past two years as well as for the next fiscal year.

The important international latitude observatory at Ukiah, Cal., should not be abandoned. The board of directors of the Astronomical Society of the Pacific, feeling that the European war might make it necessary for the International Geodetic Association

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to abandon its work at the variation of latitude observatories, passed the following resolutions at the meeting on November 30, 1914:

Whereas, it has come to the attention of this board that the work of the international latitude observatories is threatened by the present war in Europe, and that some of the stations may be closed: *Be it*

Resolved, That it is the sense of the Astronomical Society of the Pacific that the work of these stations is of the greatest importance, and that every effort should be made to continue the stations in this country even though others are necessarily closed.

Resolved, That the president and secretary of this society be authorized and instructed to present the views of this society to the proper authorities of the United States Government and urge upon them the desirability of making some special provision for the maintenance of the stations in this country.

The estimates for the Coast and Geodetic Survey for the year 1917 contain a provision for the expenditure of such funds as may be necessary, up to $2,500, for the maintenance of the observatory at Ukiah, Cal., if the International Geodetic Association is not able to continue this observatory in operation on account of the lack of funds or for any other reason while the European war is going on. It should be understood that after the war is over the association should resume the observations at the Ukiah Observatory as soon as practicable.

Suboffices.

The Coast and Geodetic Survey has now suboffices at Manila, Seattle, New York, San Francisco, Galveston, Boston, and New Orleans. The Galveston office was started in May of this year, through the interest of the chamber of commerce there, which placed at the disposal of our inspector office room and a clerk, having the understanding that an effort would be made to secure the necessary funds next year to maintain this office.

The Boston and New Orleans offices are conducted in cooperation with the Bureau of Foreign and Domestic Commerce, and are in the charge of officers of that Bureau, who have files of Survey publications and charts for the information of those interested who may call to consult them. The suboffices at San Francisco, Seattle, New York, and Galveston have only one officer of the Survey at each.

The Seattle suboffice is found to be useful to the Washington office in securing information and otherwise assisting in carrying on the routine business in connection with the surveys of Oregon, Washington, and Alaska. It becomes more evident each year with the increase of commercial activities along the coast of Alaska that this suboffice can not give adequate attention to such a large ter-

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ritory. Therefore the need may arise of a suboffice in Alaska at a suitable point, such as Juneau.

On the Atlantic coast, in addition to the suboffices that we are now trying to maintain, it would be helpful to have a suboffice at Norfolk.

These offices are proving very useful to the maritime public and others in their localities by enabling them to obtain information immediately and directly. Owing to the lack of funds, these offices are restricted in their activities to office routine almost exclusively. Funds are needed to provide each of these offices with a clerk in addition to the officer in charge, so that the clerk could keep the office open and enable the officer in charge to keep in touch with the inspection of the coasts in his district and make reports to the Washington office of any errors in the existing charts, the need for revision surveys, and any information of benefit to the maritime public and of use in keeping our charts revised up to date.

It would be of invaluable assistance to the Survey in keeping its charts up to date if the coasts could be divided up into inspection districts (like those of the Lighthouse Bureau and the Coast Guard) with an officer conveniently located in each, whose duty it would be to constantly inspect the coasts in his district and report to the Washington office, with recommendations, any errors, changes, etc., affecting the accuracy of the charts.

Proposed Purchase of Dutch Harbor, Aleutian Islands, Alaska, as a Federal Government Base.

A serious problem confronts the Government in reference to a supply base in western Alaska for coal, oil, and other ship supplies. At the present time Unalaska is the headquarters of the Coast Guard cutters and acts as a supply base for Government vessels; but the arrangement is not ideal, for several reasons.

First, the harbor is poor. The only means of reaching the wharf is through a narrow and crooked channel, which is dangerous to a vessel of ordinary size. Second, at this place the Federal Government has paid many thousands of dollars to a private company for coal transported from Australia, Canada, and the United States, besides incurring other annual expenses in payment of various privileges received. As it is necessary for Government vessels to dock at a private wharf, and to accept courtesies in connection therewith, it thereby places them more or less under obligation to a private concern. Third, there is a poor fresh-water supply at Unalaska, and the buildings are inadequate.

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In view of the fact that commerce has greatly increased in this section of Alaska, it is quite necessary and natural to look for a *permanent* supply base. Upon investigation it would seem that Dutch Harbor, the abandoned village and home of the North American Commercial Co., is the logical place for the Federal Government to own. The only wireless station in this section is located close to this deserted village, making it easy of communication; the harbor is excellent, with ample room for sufficient wharves; and there is a liberal fresh-water supply. The buildings of this company are in *more* than a fair state of preservation, and besides the good buildings there are coal yards with trackage for hauling coal, scales, derrick, and practical storage bins, already built. As has been stated, the entire village is deserted and can be acquired as a whole. Considering all this, it would be highly advisable for the Government to negotiate at an early date for the purchase of this settlement.

The Department of Commerce would be greatly helped by having such a permanent Government station in this isolated section of Alaska. This Department is carrying on important work in that region at the present time, and the natural expectation is that it will do much more each year. It is necessary for our vessels to have a place where they may readily and cheaply secure their coal, which has not been the case heretofore; the new vessel of the Coast and Geodetic Survey, which will probably do much work in this territory, is an oil burner, and could be supplied with her fuel from Government tanks, and not from those of a private company.

The Bureau of Fisheries, with its great interests, is custodian of the Pribilof Islands; its vessels will ply back and forth from the islands to eastern Alaska, as well as to Seattle, and this will make this point a valuable one from which to replenish fuel and other supplies.

The Lighthouse Bureau will also be greatly benefited because of its tenders being in that region at intervals while carrying on their specific work.

One of the most important features is that the Coast Guard, which have made their headquarters at Unalaska in the past, and which have for some time earnestly recommended the purchase of this property, will feel the benefits to a great extent.

There are thousands of tons of fuel used by all the Government vessels in that section, which, at present, are purchased from private concerns at large figures; while if the Government owned

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its own supply base this same fuel could be furnished from Government bins and tanks, brought there from Government-owned mines and oil wells on Government vessels and colliers. In this way the cost of the purchase of this property would soon be realized in the saving on these supplies. It is earnestly hoped that the coming Congress will act favorably on this recommendation.

General Summary of Field Operations—Vessels and Parties.

Atlantic coast.—The steamer *Bache* was employed on offshore hydrography off the coasts of South Carolina, Georgia, and Florida. This work, much of which was out of sight of land, was done with an accuracy never before attempted in this class of work, and yet due to improved methods the cost of the work is less than that heretofore done by this vessel. These surveys are a permanent addition to an accurate knowledge of our coasts.

The steamer *Endeavor* was engaged on the hydrographic resurvey of Delaware Bay Entrance. This vessel was condemned November 11, 1914, as unfit for further use and sold under sealed proposals to the highest bidder, May 12, for $1,015.50.

The steamer *Hydrographer* was employed in supplementing the hydrographic surveys of Long Island Sound between Execution Rocks and Norwalk Islands, including Oyster Bay. Many dangers to navigation were discovered. Afterwards the *Hydrographer* was engaged on resurveys in Albemarle Sound, N. C., and in the vicinity of Sandy Hook, N. J.

The steamer *Isis* was chartered May 2, in anticipation of her purchase by the Survey July 1, at which time the funds became available. Plans were prepared to fit her for surveying work.

The schooner *Matchless* completed revision work in certain places in Chesapeake Bay and began a general resurvey of Albemarle and Croatan Sounds, N. C.

Chart revision work has been done in Passaic and Hackensack Rivers, N. J., and a resurvey of Arthur Kill begun.

A resurvey was made of Great South Bay, Long Island, and a topographic and hydrographic survey of Jamaica Bay was completed. Signals for hydrography were erected on the coast of New Jersey. The survey of the water front of Philadelphia was revised. At the request of the Bureau of Fisheries a triangulation was made in St. Vincent, Fla.

Field revision work for correction of the Atlantic Coast Pilot was done in Chesapeake and Delaware Bays; in the inland waters

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on the coast of New Jersey; from Point Judith to New York and up the Hudson River; on the south shore of Long Island; in the approaches to the Cape Cod Canal; and on the Gulf of Mexico from Key West to the Rio Grande.

Physical hydrography in the Potomac River, undertaken at the request of the Public Health Service, was completed.

A revision was made of the chart of Salem Harbor, Mass.

Inspection duty for the region between Narragansett and Delaware Bays was continued by an officer of the Survey with headquarters in New York City. An inspector for the Gulf coast was appointed with headquarters at Galveston, Tex.

A stock of publications, including charts, of the Survey will hereafter be kept at all suboffices and on the vessels of the Survey and on certain of the vessels of the Bureau of Lighthouses and Bureau of Fisheries.

Pacific coast.—The steamer *Explorer* completed the survey of Knik Arm, Alaska, and made an examination at the mouth of Woodrow Creek for the Alaskan Engineering Commission.

Afterwards the *Explorer* made surveys and examinations in Seldovia Bay; north of Montague Island and between Hinchinbrook and Smith Islands; between Perry and Lone Islands and on the bar between Culross and Esther Islands. An examination was made of the edge of a flat off Sheep Creek. In the spring wire-drag work was done in Richs Passage, Wash.

The steamer *Gedney* made surveys in the waters west of Prince of Wales Island, including Klawak Inlet, Tonowek Bay, Trocadero Bay, Meares Passage, and Sukkwan Strait. An improvised wire drag was used in some localities. The survey of the main ship channels on the west side of Prince of Wales Island and of a safe inside channel from Tonowek Bay to Sea Otter Sound was completed.

The steamer *McArthur* was engaged in general surveys in Nichols Passage and Felice Strait. A wire drag was used in some localities to supplement the soundings. The survey was carried through Nichols Passage and into the northern part of Felice Strait. A search was made for a reported shoal in Portland Canal. In the spring revision work was done in Richs Passage, Wash.

The steamer *Patterson* was engaged in general surveys in the Shumagin Islands and adjacent mainland of Alaska. Sounding lines were run between the islands and Unimak Pass and in the locality of the reported Lenard Rock and elsewhere. A bank off Cape Sarichef was developed. The triangulation was extended

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from the Shumagin Islands to Kuiukta Bay and a hydrographic reconnoissance was made of the same area.

In September and October the *Patterson* made a voyage of 1,700 miles to the assistance of the revenue steamer *Tahoma*, wrecked on an uncharted reef in the western Aleutians. Twenty-nine of the officers and crew were picked up and brought back to Unalaska.

In returning to the field of work in Alaska in the spring a rock in Whale Passage was located by the *Patterson*.

The steamer *Taku* completed the hydrography and topography of Passage Canal and Landlocked Bay, and the triangulation of Landlocked and Fidalgo Bays. In the winter revision work in the vicinity of Seattle, Wash., was done by the chief of this party.

A party extended a triangulation across the (Alaska Peninsula) glacier between Passage Canal and Turnagain Arm, which connects the triangulation systems of Cook Inlet and Prince William Sound.

Work was resumed in June, 1915, in Ports Gravina and Fidalgo.

The steamer *Yukon* discovered and charted a good channel from Kuskokwim Bay through the extensive flats into the Kuskokwim River. This opens up an extensive region in Alaska which was previously quite inaccessible and the transportation charges so high as to practically prohibit development. The survey of the Kuskokwim was resumed in June, 1915.

Wire-drag work in Tongass Narrows, Alaska, was begun in July, 1914. This work required some preliminary triangulation and topography. Wharves were located at Ketchikan and corrections made to the shore line of Revillagigedo Channel. Drag work was done in Tongass Narrows, Nichols Passage, Port Chester, and Revillagigedo Channel. Work was resumed in May, 1915. In 1914, 21 dangers were reported, of which 11 were of the first importance. In May and June, 1915, several dangerous rocks were discovered.

In May, 1915, a second wire-drag party began work in Sumner Strait, Alaska, in the vicinity of Bluff Island. By June 30 drag work had been carried northward nearly to Point Baker. Drag work was done on the eastern side of the strait, including Calder Rocks. Triangulation and topography were done for control of the drag work.

A resurvey of Yaquina Bay, Oreg., was completed.

Current observations were begun with the cooperation of the Bureau of Lighthouses at five light vessels on the Pacific coast.

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Inspection duty for the coast of California has been continued by an officer of the Survey, with headquarters at San Francisco, and for the coasts of Alaska, Oregon, and Washington by an officer with headquarters at Seattle.

Hawaii.—In the Hawaiian Islands the revision of the triangulation and topography of the island of Hawaii was completed, and that of the island of Molokai begun.

Philippine Islands.—The field work in the Philippine Islands is under the immediate direction of the director of coast surveys at Manila.

The steamer *Fathomer* has operated chiefly in the area between the islands of Panay, Cuyos, Mindoro, and Calamianes. Combined operations were carried on in this region, but the hydrography was the principal work.

The steamer *Marinduque* made general surveys in the vicinity of Palawan Island and the Calamianes Group.

The steamer *Pathfinder* was engaged in general surveys in the southwest and east coasts of Mindanao, in the Sulu Sea, and in San Bernardino Strait. A special survey was made of Palmas Island.

The steamer *Research* continued general surveys in Ticao Pass and vicinity on the coast of Panay, and on the west coast of Luzon and eastward of Delian Island, including Magallanes Bank.

The steamer *Romblon* was at work in the same general region as the *Fathomer* and *Marinduque* and more particularly around Linapacan and Culion Islands and between Palawan and the islands offshore to the eastward.

Geodetic work.—The triangulation between Memphis, Tenn., and Huntsville, Ala., begun during the previous year, was completed. The erection of signals and station marking on this arc had previously been done by a separate party.

After this work was done a reconnoissance was made to connect the triangulation in the vicinity of Louisville, Ky., with the transcontinental arc in the vicinity of North Vernon, Ind. Signals were erected and stations marked for this work, and the observation of angles was then begun and carried to completion.

Reconnoissance for primary triangulation and preparation of stations for the observing party in Idaho were begun in May, 1915, and were in progress at the close of the fiscal year. The observation of angles on this work was begun in the latter part of June. Automobile trucks were used for transportation both of the recon-

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noissance and observing parties. This triangulation was undertaken at the request of the U. S. Geological Survey.

The arc of secondary triangulation extending from Juan de Fuca Strait to Grays Harbor, a distance of 110 miles, was completed during the year. This was a work of great difficulty, owing to the absence of trails and the densely wooded character of the country. It was necessary to elevate the theodolites, heliotropes, and lamps above the timber, many of the instrument stands being more than 100 feet high.

Precise leveling was done on a line extending from Butte, Mont., to Pasco, Wash., by way of Spokane, and also a short line from Sand Point, Idaho, to the Canadian boundary.

In the spring of 1915 a line of precise levels was run from Seattle to Blaine, Wash., to connect with bench marks of the Canadian Geodetic Survey. Work was begun on a line from Huntley, Mont., to a point on the Great Northern Railway in the vicinity of Mondak, Mont. At Louisville, Ky., a line of levels was run connecting a station in the triangulation with a bench mark in the line of precise levels.

A line of precise levels was run between Minot, N. Dak., and Devon, Mont., and work was begun on a line from Carson City to Las Vegas, Nev. The latter line was undertaken at the request of the U. S. Geological Survey.

Precise leveling was also done on a line between Perth Amboy and Sandy Hook, N. J.

The total amount of precise leveling done during the year was 980 miles.

Observations were made for the determination of the astronomic latitudes of a number of points along the Texas-California arc of primary triangulation, and the oblique boundary between Nevada and California. The rapid progress made in this work was due in a large measure to the use of an automobile truck for transportation of the party engaged in the work and its equipment.

A determination was made of the difference of longitude between Far Rockaway, N. Y.; the Naval Observatory, Washington, D. C.; and Cambridge, Mass. This work was done as a part of a plan to determine by cable the difference of longitude between Far Rockaway, N. Y., and Borkum, Germany. The cable determination was interrupted by the European war.

The differences of longitude were determined between old longitude stations and triangulation stations of the Memphis-Huntsville arc and of the Louisville connection.

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Astronomic latitude was also observed at five stations, and azimuth was determined at five stations.

Determinations of the intensity of gravity were made at a number of stations in the eastern part of the United States.

Magnetic work.—The usual magnetic and seismographic observations were recorded during the year at the magnetic observatories of the Survey at Cheltenham, Md.; Tucson, Ariz.; Vieques, P. R.; Sitka, Alaska; and Honolulu, Hawaii.

Magnetic observations were made in the field at a large number of stations in the United States and meridian lines were established in many places. Observations were made at sea and on land by field parties of the Survey when practicable.

A large number of requests for information in regard to magnetic declination have been received and the information furnished.

Tides.—Tidal observations were made in connection with hydrographic surveys in the United States and its outlying territory and at regular tidal stations at Portland, Me.; Fort Hamilton, N. Y.; Atlantic City, N. J.; Philadelphia, Pa.; Baltimore, Md.; Key West, Fernandina, St. Augustine, and Cedar Keys, Fla.; Galveston, Tex.; San Diego and San Francisco, Cal.; Seattle, Wash.; and Juneau, Alaska. Tidal indicators exhibiting automatically the stage and height of the tides were maintained at Fort Hamilton and at New York City, N. Y., and Reedy Island, Delaware River.

With the cooperation of the Bureau of Lighthouses, observations of currents were made at a number of light vessels on the Atlantic and Pacific coasts. Similar observations were made when practicable by the hydrographic parties of the Survey.

International Boundaries.

Until April 15, 1915, the Superintendent of the Coast and Geodetic Survey was commissioner on the part of the United States for the survey and marking of the boundary line between the United States and Canada, and under authority of the State Department supervised the work of the boundary parties. After the resignation of the former Superintendent, a new boundary commissioner, not an officer of the Survey, was appointed. The Survey still cooperates with the work of the Boundary Commission in every way possible, but the officers engaged in that work no longer report to the Coast and Geodetic Survey, and consequently the annual report of the Superintendent contains abstracts only of the work done up to the time of the appointment of the new commissioner.

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Parties were engaged during the summer season of 1914 as follows:

The numbering of the monuments on the boundary from the Continental Divide to the Lake of the Woods; the survey and monumenting of the boundary on Rainy Lake and Rainy River; the survey and monumenting of the boundary between the mouth of Pigeon River and Lake of the Woods; and the survey of the northeastern boundary in the vicinity of Halls Stream.

Assistance Rendered in Saving Life and Property.

In September and October, 1914, the steamer *Patterson* made a voyage of 1,700 miles and rescued a part of the officers and crew of the revenue steamer *Tahoma*, wrecked on a reef in the western Aleutian Islands.

In July, 1914, assistance was rendered by the steamer *Endeavor* to the lighthouse steamer *Iris*, with the Secretary of Commerce and other officials on board, which had gone aground during a sudden storm at Lewes, Del.

In February the officers and crew of the schooner *Matchless* rendered efficient service in extinguishing a fire on shore at Edenton, N. C.

In June, 1915, the steamer *Gedney* rendered assistance to the fishing schooner *Poloris* by hauling her off Klawak Reef, at the north end of Fish Egg Island, Alaska, on which she had run aground.

In May, 1915, the steamer *Pathfinder* assisted the schooner *Alpene*, of San Francisco, off the north end of Capul Island, San Bernardino Straits. The *Alpene* was towed to a safe position at sea.

The steamer *Explorer*, while at work at the entrance to Woodrow Creek, Alaska, rendered assistance to the steamer *Bertha*, which had been caught by a strong current while at anchor and was in danger of foundering.

Publications.

The primary object of the Coast and Geodetic Survey is the publication of charts for navigational purposes. Every other function, however important, is subordinated to that end.

No less important than the issue of new charts of localities which have been accurately surveyed for the first time is the prompt correction of the existing charts, as the result of natural or artificial changes.

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Advance information in regard to newly surveyed regions is issued in the form of preliminary charts as soon as the results become available.

Improvements have been made of late years in the methods of chart printing and in the form and arrangement of the charts themselves.

The Mercator projection is being substituted for the polyconic projection on certain classes of charts. The new charts have their sides parallel or normal to the meridian and the details of the land are much simplified. The substitution of the foot for the fathom as the unit of soundings on large-scale charts of the Atlantic and Gulf coasts has been decided upon and meets with general approval.

The accommodations for chart printing have been improved by the erection of a new building and the extension and repair of the old building used for that purpose.

The geodetic and magnetic results of the Survey are issued in the form of special publications as rapidly as they can be prepared.

The geodetic and magnetic results are largely used by other bureaus of the Government, by civil engineers and surveyors, and by State and municipal authorities interested in works of development and improvement.

The Coast Pilot volumes, containing detailed descriptions of the coasts of the United States, with sailing directions for the navigable waters, are being constantly revised and corrected from the most recent information available. Inside-route pilots are issued for the use of the immense fleet of small craft navigating the shallower protected waters along our coasts.

Tide tables are issued, giving predictions for a year in advance of the state of the tide on each day of the year for all important localities on the coasts of the United States and at a number of foreign ports.

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STEAMBOAT-INSPECTION SERVICE.

Personnel.

The force at the disposal of the Steamboat-Inspection Service is as follows:

At Washington, D. C.:	
Supervising Inspector General	1
Chief clerk (who is Acting Supervising Inspector General in the absence of that officer)	1
Clerks	7
Messenger	1
In the Service at large:	
Supervising inspectors	10
Traveling inspector	1
Local inspectors of hulls	47
Local inspectors of boilers	47
Assistant inspectors of hulls	41
Assistant inspectors of boilers	42
Clerks to boards of local inspectors	69
Total	267

Summary of Activities.

Two permanent positions (traveling inspector and one clerk in the office of the Supervising Inspector General) were added to the Service during the year. It will be noted that the Service comprises 10 persons in Washington and a field force of 257. This force inspected and certificated in the fiscal year 1915, 7,553 vessels, issued licenses to 18,412 officers of all grades, inspected at the mills 2,962 steel plates for the construction of marine boilers and a large amount of other boiler material, and examined 11,554 boilers; 5,022 applicants were examined for visual defects. Passengers to the number of 307,348,008 were carried on vessels which are required by law to report the number of passengers carried. The number of accidents resulting in the loss of life during the fiscal year was 190, and the number of lives lost was 368, including both passengers and crew—a decrease from the previous year of 214. Of the lives lost, 153 were from suicide, accidental drowning, and other causes beyond the power of the Service to prevent, leaving the loss of 215 lives as fairly chargeable to accidents, collisions, explosions, foundering, etc. The lives of 107 passengers were lost, which, compared with the number carried, shows a

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ratio of 1 life lost for every 2,872,411 passengers carried. There was a decrease of 377 in the number of vessels inspected and a decrease of 2,247,471 tons in the tonnage of vessels inspected, compared with the previous fiscal year. This was chiefly because by reason of the war fewer foreign vessels were examined. There were certificated 5,946 domestic steamers and 321 foreign passenger steamers. There were inspected 28 sail vessels and barges, 565 seagoing barges, and 693 motor vessels. During the year there were examined and tested 161,335 life preservers. There were 3,120 reinspections of passenger and ferry steamers made by boards of local inspectors during the year, although for lack of money all reinspection work had to be stopped on June 10, during one of the heaviest months of navigation. This was particularly unfortunate, because reinspections are made without prior notice to the vessel and afford an invaluable means of supervision.

During the fiscal year 53 vessels were refused certificates of inspection, 271 boilers failed under hydrostatic pressure, 1,309 boilers were found defective from other causes, 75 boilers were condemned from further use, and a total of 25,206 defects in boilers and various attachments were discovered. A total of 295 licenses were suspended, revoked, or canceled; 341 licenses were refused. Seven hundred and ninety-four cases of alleged violations of the law were investigated. Full details of the Service in all its parts, and with reference to each inspection point in each of the 10 districts, will be found in the report of the Supervising Inspector General.

During the year the work of the traveling inspector, a new officer established during the fiscal year who began service on November 2, 1914, was of special value. This officer traveled over 11,000 miles, inspecting 253 vessels in use, and found and reported 247 deficiencies of various kinds, which are detailed on page 818 of this volume.

Speaking generally, during the last fiscal year the Service inspected 271 fewer steam vessels, 116 more motor vessels, and 224 fewer foreign passenger vessels. There was an increase of 43,291 tons in the tonnage of seagoing barges inspected, an increase of 355 in the Government boilers inspected, and an increase of 75 in the total number of reinspections made, though this work was cut short for lack of money, as before stated.

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Urgent Needs of the Service.

The Service is undermanned. It has an insufficient clerical force. The field force is at times seriously overworked. It has not the requisite technical staff, and the funds provided for its general expenses (contingent fund) are insufficient. It may be set down as a fact that a service of this kind can not do its work any better than the public allows it to do it. The public is supposed in this to speak through its lawful representatives. The needs of the Service have been most explicitly made clear. In my last annual report, page 180, I said:

It is useless to pass more exacting laws or for the Board of Supervising Inspectors to go into any greater detail in the matter of the Rules and Regulations until Congress shall have given the Steamboat-Inspection Service enough men to enforce the laws and carry out in an intelligent manner the rules that already exist. In some districts men are required to work from 5 o'clock in the morning until 10 or 11 o'clock at night. Such a condition is wrong. A great and powerful Government such as ours should certainly provide a sufficient number of inspectors to properly perform these duties. If disasters occur as a result of lack of thoroughness, the responsibility will not rest upon the Steamboat-Inspection Service. The importance of this matter should be clear to Congress, and, as already stated, it should not be necessary for a great disaster to occur before the necessary steps are taken to prevent further disaster.

I added:

Systems are of no effect, and organization amounts to nothing, if sufficient men are not furnished to properly operate the machinery. The Steamboat-Inspection Service is so organized as to be capable of indefinite expansion, but it is to-day up to the limit of its endurance. The cry of the Service is for more men, and unless more men are furnished the proper standard of inspection can not be maintained.

This I now reaffirm. The statement of last year bore little fruit. One additional clerk was allowed and one traveling inspector was permitted for the fiscal year 1915. Three assistant inspectors in New York were granted for the fiscal year 1916, instead of the six asked. That is all. It was not enough, and the overstrain went on and still continues.

Wishing to make the matter so plain to the public that no responsibility might in this respect rest upon the Department, the statement was made to the New York Maritime Exchange on December 3, 1914, of which quotation is made in the early pages of this report. The following was added:

The Service is undermanned; we need now six more assistant inspectors in New York, two more in Boston, others elsewhere. Let me be very practical. Do not criticize us for delay if after knowing we are short of men you do nothing to help us get them. Public opinion is the power that rightly governs legislatures and you can express it. In Buffalo and elsewhere our inspectors work often for long periods—from 7 a. m. to 10 p. m. continuously. I am calling on them always for more and better

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work, but there is a limit to human powers. Unless we have more men here and elsewhere I give you definite warning that we must soon do less work or do it less well. Now in advance, before anything happens, I tell you plainly of it.

A statement showing the conditions in the harbor of Buffalo was filed with the Appropriations Committee on November 28, 1914, and appears on page 126 of the hearings on the legislative, executive, and judicial appropriation bill for 1916, Sixty-third Congress, third session. In that city, since there has been an increase in the force, the tonnage in the harbor has grown from 158,000 to 560,000. A similar condition prevails elsewhere. At that time I stated to the committee:

The Supervising Inspector General reported to me about a month ago that we had reached the limit of our rope; that we had gotten to the point where we must now choose between leaving our work go less well done or having a sufficient force to carry it on.

This condition has not improved but has become worse since the enforcement of the seamen's law has imposed upon the Service a very large amount of new work for doing which no provision whatever has been made. This new law has imposed 15 or more new duties on a force already overworked without any additional compensation or assistance.

The Steamboat-Inspection Service was charged during the past year with the protection of the lives of over 300,000,000 passengers, with the safety of the investment in over 7,500,000 tons of vessels, and in a measure with the security of the millions of tons of cargo those vessels carry. This is its task, but it is not fully equipped for that task, and the officer in charge of the Service is paid less than any of his associates, save one, occupying a similar post of responsibility. Our estimates will include a request that his salary be raised from $4,000 to $5,000.

Wide Limits of Certain Inspection Districts.

On behalf of shipowners and shippers and passengers alike, I protest against a continuance of these conditions. I protest against the absurdity of one supervising inspector on the Pacific coast being charged with the supervision of the coasts of California, Oregon, Washington, Alaska, and Hawaii, including the navigation on the Sacramento, Columbia, and Snake Rivers. (See chart on opposite page.) No man is competent for such a task, yet a request that this vast district be divided into two and another district be created at Seattle was refused. If the Steamboat-Inspection Service is to be held accountable by the public for the work with which it is charged, then it must in fairness be

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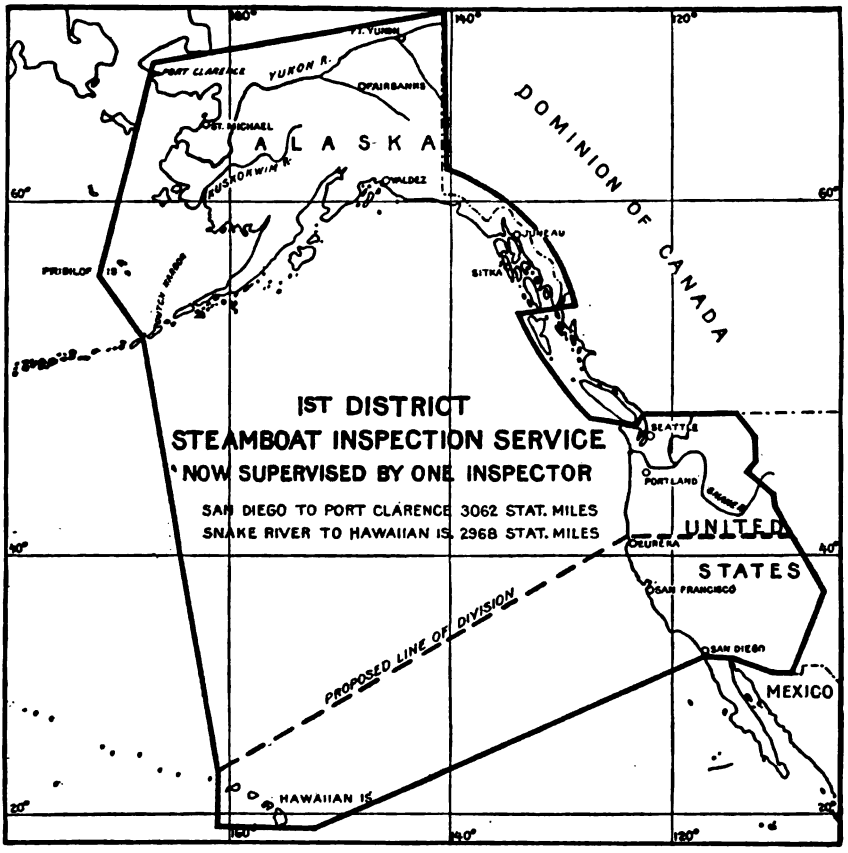
given the men and the means to do that work. If it is not given the men and means sufficient for the work, then it can not be held accountable. It is hardly just to impose sweeping powers by law upon a service and then by lack of men and means so limit that power that it can not be properly exercised. It is only fair to the men who have made an admirable record in the Service that these things be made plain.



The law requires (sec. 4406, R. S.) that "each supervising inspector shall watch over *all parts* of the territory assigned to him, shall *visit*, confer with, and examine into the doings of the local boards of inspectors within his district, and shall instruct them in the proper performance of their duties," etc., and also provides (sec. 4408, R. S.) that "the supervising inspectors shall see that the several boards of local inspectors within their respective districts execute their duties faithfully, promptly, and, as far as possible, uniformly in all places," etc.

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It is obviously impossible for the supervising inspector of the first district to carry out this law, for two reasons: First, because no human being could do it in a district reaching from Nome to San Diego and from Idaho to Hawaii; and second, because if such a fabulous person could be found funds are not provided sufficient to cover the necessary traveling expenses. It is only with less difficulty that the supervising inspector of the tenth district (see chart on opposite page) can carry out the requirements of the law in a district which reaches from western Texas to Porto Rico.

A bill will be introduced to divide the first district into two, the new district to consist of the local inspection districts of Seattle, Wash., Portland, Oreg., Juneau, Alaska, and St. Michael, Alaska, with the supervising inspector stationed at Seattle, Wash., and the balance of the old first district to include the local inspection districts of San Francisco, Cal., Los Angeles, Cal., and Honolulu, Hawaii, with the supervising inspector stationed at San Francisco.

The policy has been to impose the largest responsibility over what seems, in these two cases at least, the greatest possible area, and then to provide an insufficient clerical and inspecting force to do the work, meanwhile holding the Service to a searching accountability, which, however just it might be were the men and means sufficient for the work, is under existing conditions a grave injustice. The public simply know there are inspectors charged with certain duties. They do not know how the ability to perform those duties is limited by insufficient force and narrow funds. They can not, therefore, discriminate and their condemnation may unjustly fall, when accidents may occur, upon men who are doing all possible under adverse circumstances to protect the lives of the people of a great and powerful nation, which has not, however, provided means for doing the work with which it charges them.

The estimates of the Bureau have been trimmed to the bone by the Department itself before submitting them, but these have been still further cut when appropriations are made, with unfortunate results. The supervising inspectors are instructed that they must spend as much time as possible in the field carrying out specifically the express commands of the law, but this will mean that a considerable addition to the funds of the Service available for traveling must be provided.

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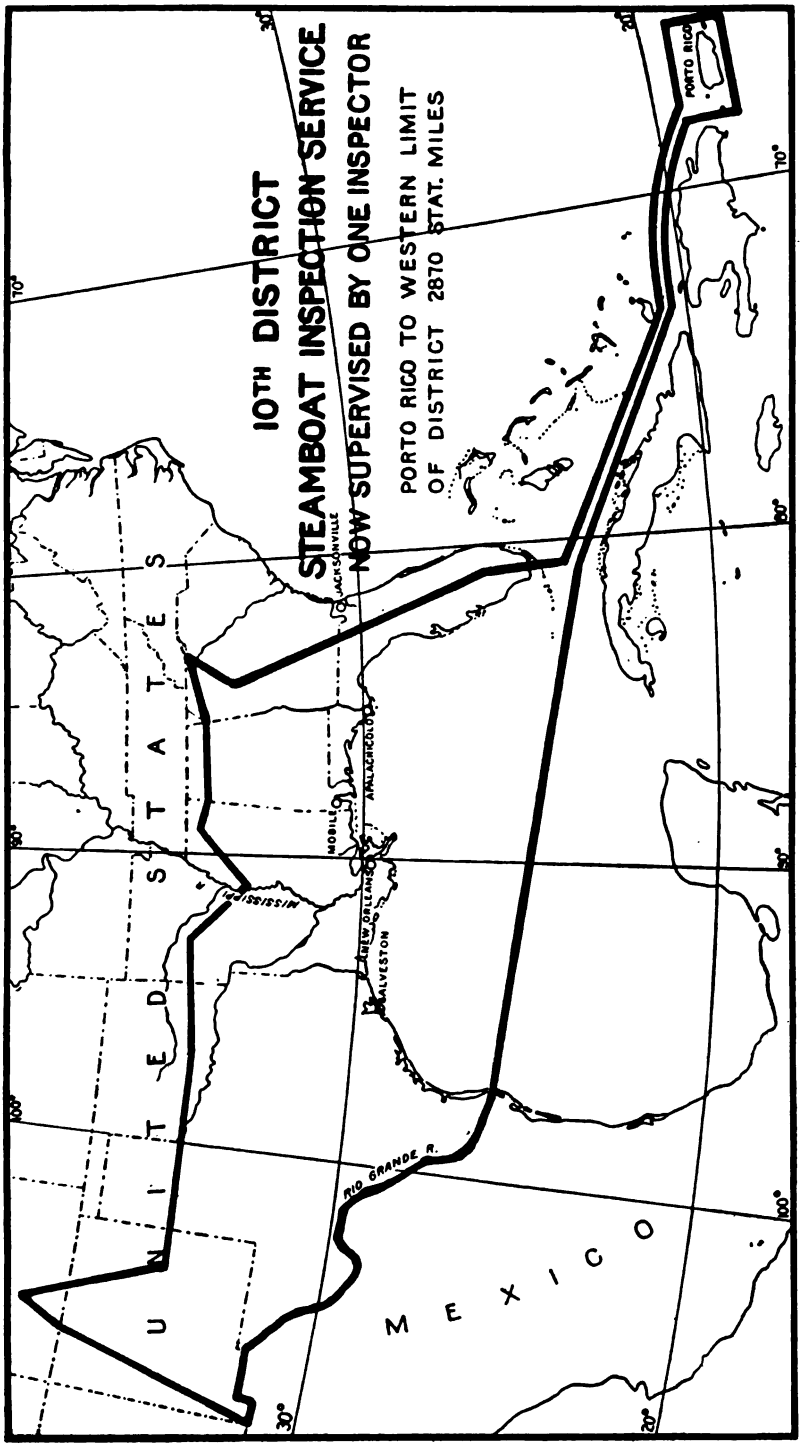

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Inquiry into the "Eastland" Disaster.

In the early part of this report I have referred to the *Eastland* disaster, which, while it did not occur until shortly after the close of the fiscal year, has nevertheless received so much public attention as to require mention here. A copy of my report to the President dated August 10, 1915, together with the statement unanimously made by the board of inquiry dated August 5, 1915, follows:

PITTSFIELD, MASS., *August 10, 1915.*

The PRESIDENT,

The White House, Washington, D. C.

SIR: The news of the disaster to the steamship *Eastland* reached me at Syracuse, N. Y., on the afternoon of Saturday, July 24. Hon. Edwin F. Sweet was in charge of the Department in Washington. George Uhler, Supervising Inspector General of the Steamboat-Inspection Service, had gone to the Pacific coast, and Mr. D. N. Hoover, jr., Deputy Supervising Inspector General, was in charge of the Service. Mr. Sweet left Washington for Syracuse Saturday evening and conferred with me on Sunday, 25th. Mr. Hoover was immediately ordered to Chicago, and arrived there Monday morning, 26th. Mr. Sweet returned to Washington Sunday night, 25th, and on the 26th sent Mr. A. L. Thurman, Solicitor of the Department, to Chicago, whither I proceeded myself on the 26th, both arriving on the morning of Tuesday, 27th. You were advised by telegram of my departure. I think it proper to make it a portion of this record that the above action was taken of my own initiative and without direction or instruction of any kind.

The Revised Statutes of the United States require that every steamboat accident causing loss of life or property shall be investigated by a local board of inspectors, and gives to such local board the powers of a United States court for summoning witnesses and administering oaths. This is a procedure which takes place automatically under the law; no one calls for the investigation; no one orders it. It is a procedure which is taking place frequently all over the country. In this case, because of the gravity of the occasion, I deemed it proper that it should be conducted under the supervision of the Solicitor of the Department and myself. I may add for the sake of the record that the Solicitor is an officer of the Department of Justice assigned as legal adviser of the Department of Commerce.

On arrival at Chicago we found that the vessel had been officially inspected and reinspected by the local board at Grand Haven, Mich., and that examination had been several times made of her life-saving equipment during the current year by the local inspectors at Chicago. Under these circumstances, it seemed wise to call upon the local board at Milwaukee to conduct the inquiry required by law, since they had had no part in any inspection of the vessel of any nature. In order that the inquiry might be distinguished as far as practicable under the law from a purely departmental proceeding, I ventured to ask the assistance of Mr. Marvin B. Pool, a well-known merchant of Chicago, and of Mr. Harry A. Wheeler, a banker of that city, to act as unofficial members of a board of inquiry. To them I desired to add a well-known labor leader, but was embarrassed in securing such by the fact that some, if not most, of those immediately concerned had expressed their views publicly in advance of the hearing. I did not think it fit to call as an unofficial member of the board of inquiry anyone whose opinion had been expressed beforehand. Receiving a suggestion from Lieutenant Governor Barratt O'Hara respecting the desirability of the presence on the board of inquiry of some representative of organized labor, in which I fully concurred, I asked the lieutenant governor himself to accept, which he very kindly did, and continued to act throughout the inquiry save for one day's

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absence on official business, on which occasion he sent his father to take his place. Mr. Philip B. Fouke, from St. Louis, chairman of the committee on the Steamboat-Inspection Service of the Chamber of Commerce of the United States, also kindly accepted an invitation to be present and act as one of the unofficial members of the board. On Wednesday, the 28th inst., Supervising Inspector General George Uhler arrived in Chicago from San Francisco, and Mr. Hoover returned to Washington to take charge of the Service there. At a later period of the inquiry, Naval Constructor James L. Ackerson, United States Navy, was kindly sent by Secretary Daniels to assist me and also acted as an unofficial member of the board of inquiry, as did Mr. E. C. Gillette, superintendent of marine construction, United States Lighthouse Service, who came to Chicago at my request. The professional knowledge of both was of great service in the inquiry, and both were present during the consideration of the final statement made by the board.

The first hearing of the board of inquiry took place upon Thursday, July 29, in the court room of Judge Kohlsaat, which was kindly put at our disposal. At its very outset an invitation was extended to all who had any knowledge that would throw light upon the subject of the inquiry to make such facts known to the board. No one accepted this invitation. The proceedings of the board were public, and the State's attorney, the office of the corporation counsel, the public administrator, the Congressman from the district chiefly concerned, Judge Sabath, and others were invited to take part in the questioning of witnesses and availed themselves freely of this privilege. As a matter of fact, therefore, the witnesses were examined not only by representatives of the Department of Commerce and of the Department of Justice, but by officers representing the State of Illinois and the city of Chicago and Cook County, as well as by Congressman Sabath and others. This may be illustrated by the case of Inspector Reid, the only one of the inspectors conducting the official inspection of the vessel who came before us. He was examined first by myself, then by Mr. Thurman. He was then cross-examined by Mr. Sullivan, assistant State's attorney, by Judge O'Hara, who for that day took the place of his son, the lieutenant governor, by Congressman Sabath, by Mr. Stebbins representing the corporation counsel, and by Mr. James L. Bishop, the public administrator. He was, in addition, questioned by others upon the board of inquiry. The record will show, therefore, that this inspector was examined by an officer of the Department of Commerce, one of the Department of Justice, and was cross-examined searchingly by five persons, and questioned to some extent by others.

It is proper to state that only the most cordial relations existed from beginning to end between Mr. Thurman and myself upon the one hand, and the State's attorney, Mr. Hoyne, the Federal district attorney, Mr. Clyne, his honor Judge Landis, of the Federal district court, the office of the corporation counsel, of the public administrator, and all other State, county, city, and Federal officers. In particular, the collector of the port was most courteous and helpful throughout, and our consultation with the officers of the Department of Justice in the office of the Federal district attorney was constant and pleasant.

A complete stenographic record of the proceedings was kept on behalf of the board of inquiry itself, and another was taken on behalf of the office of the State's attorney. I appeared with Mr. Thurman and Supervising Inspector General Uhler before the coroner's jury, and General Uhler and I appeared before the State grand jury.

On my arrival at Chicago, I announced through the press that the officers of the Department of Commerce would aid in every possible way to throw light upon the cause of the disaster and upon its own Service and that it would welcome the assistance of others and would cooperate with any authorized authority to a like end. For this purpose, Local Inspectors Reid and Eckliff, who this year made the official inspection of the *Eastland*, were by my order summoned from Grand Haven, Mich., to Chicago. They were, upon their arrival, promptly arrested by the local authorities, who, however, extended to them all possible consideration until they were released

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on a writ of habeas corpus by Justice Landis. It is proper, however, to add that on one occasion, being called for as witnesses, they were brought in irons into our public hearing, a proceeding which seemed unnecessarily harsh with officers of the United States who had as yet been granted no hearing, against whom no indictment existed, and over whose acts, performed in another State and upon a vessel navigating the navigable waters of the United States, the jurisdiction of the officers of the State of Illinois was open to question.

At my direction, the supervising inspector located at Cleveland, Ohio, Capt. Nils B. Nelson, was ordered to Chicago, because he had had the *Eastland* under his supervision for six years. He appeared before the board of inquiry and was summoned as a witness before the Federal grand jury also.

Upon the issuance by Justice Landis of the order directing that witnesses subpœnaed to appear before the Federal grand jury should not be examined in any other proceeding, and upon the issuance of subpœnas to a very large number of witnesses, including the captain, chief engineer, and other officers of the *Eastland*, it became evident that it would be impracticable for the board of inquiry to determine finally the question of the conduct of the licensed officers of the vessel or the inspectors of the Department until after the grand jury should have concluded its labors, and that the result would be necessarily affected by whatever the action of the grand jury might be. It seemed, however, important that the board of inquiry should continue its study as far as was practicable in order that it might, if possible, suggest such remedial changes in the law as would tend to prevent a recurrence of similar accidents hereafter. With this in view, and with the concurrence of Justice Landis, the hearing was continued until August 5, upon which date the board unanimously concurred in the statement which has already been furnished to you, and of which the original is on file in the Department of Commerce. A copy of same is attached.

It is proper to add that the following-named persons assisted in preparing this statement and unanimously concurred therein, but their names for obvious reasons were not signed thereto:

James L. Ackerson, naval constructor, United States Navy.

George Uhler, Supervising Inspector General, Steamboat-Inspection Service.

A. L. Thurman, Solicitor, Department of Commerce.

James F. Bishop, public administrator, Cook County.

E. C. Gillette, superintendent marine construction, United States Lighthouse Service.

William C. Redfield, Secretary of Commerce.

A copy of the testimony taken at the inquiry, together with the statement of the board, will be transmitted to each House of Congress at the opening of the coming session, and the substance of this report to you and of the statement of the board of inquiry will be made a portion of my forthcoming annual report, although occurring after the close of the fiscal year to which that report refers. I propose also to include in my estimate for the forthcoming fiscal year an amount sufficient to provide for the functions which the statement recommends should be exercised by the Department of Commerce. Instructions were given on the 6th inst. to the Steamboat-Inspection Service to take the necessary steps to carry into effect the additional rules and regulations suggested by the board of inquiry. Instructions have also been given to the Steamboat-Inspection Service to call together a special committee, consisting of supervising inspectors selected from the Atlantic, Pacific, and Gulf coasts, who shall, with the supervising inspectors upon the Lakes, promptly consider what can be done, within the present lawful scope of the Steamboat-Inspection Service, to improve its effectiveness.

I have given assurance that as soon as practicable in the fall a searching inquiry will be made into the whole administration of the Steamboat-Inspection Service under the supervision of representatives of the Navy Department and of the public,

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so that there shall be no question of its impartial character. Steps to this end have already been taken, and I shall in due time confer with you as to the membership of a board to be selected for that purpose.

I beg to remain, yours, very truly,

WILLIAM C. REDFIELD, *Secretary.*

Hon. WILLIAM C. REDFIELD,
Secretary of Commerce.

In obedience to the order of the Federal Court of the Northern District of Illinois, Eastern Division, dated July 31, 1915, that no witnesses subpœnaed to appear before the Federal grand jury be examined in any other proceedings relating to the *Eastland* disaster, and in view of the fact that some of said witnesses are necessary before this investigation is concluded, adjournment is taken until after the Federal grand jury has submitted its report.

Not having completed our investigation, we are not prepared at this time to express an opinion as to who is to blame, nor what agencies contributed to the capsizing of the steamer *Eastland.*

From the evidence thus far submitted, however, we are prepared to make certain suggestions designed to further safeguard marine travel. Therefore, we earnestly urge that you transmit to the President and to the Congress of the United States the following preliminary recommendation for changes in existing laws governing the inspection of steam merchant vessels, and urge that ample force and sufficient funds be provided for a technical and scientific inspection in addition to the present practical methods employed.

1. Provide that there shall be created in the Department of Commerce a board of competent naval architects whose duty it shall be to pass (prior to their construction) upon the plans and specifications of all steam merchant vessels over 100 tons burden.

2. No steam merchant vessel of over 100 tons burden shall be certificated for service until its plans and specifications shall have been approved by the above-named board, nor until its safety, seaworthiness, and stability shall have been demonstrated to the satisfaction of said board.

3. Provide methods whereby any and all findings of the boards of local inspectors may be appealed.

4. Provide that whenever the passenger-carrying capacity of a steam merchant vessel is increased by any board of local inspectors, said increase must be approved in writing by the supervising inspector of the district.

5. Provide that any alterations of the original plans and specifications affecting stability, seaworthiness, and safety of any steam merchant vessel must have the approval of the above constituted board of naval architects.

Pending the enactment of this legislation, we suggest the following be immediately incorporated in the rules and regulations of your Department:

1. Increases in passenger-carrying permits must be issued by inspectors only after personal inspection of the vessel, of which inspection a written record shall be made.

2. All inspectors are ordered to require owners of vessels whose stability they have any reason to question to make "inclining tests" on such vessels, under the supervision of expert naval architects provided by the Department of Commerce.

Respectfully submitted.

BOARD OF INQUIRY:

Official members—
WILLIAM A. COLLINS,
FRANK W. VAN PATTEN,
U. S. Local Board of Inspection.

Civilian members—
MARVIN B. POOL.
HARRY A. WHEELER.
BARRATT O'HARA.
PHILIP B. FOUKE.

CHICAGO, ILL., *August 5, 1915.*

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Experts for Hull Construction and Increase in Number of Boiler Inspectors.

A bill to authorize the appointment of the board of naval architects suggested, with an appropriation for its maintenance, and to provide the additional powers recommended by the board of inquiry, is in preparation.

It should be noted, however, that the recommendation of the board of inquiry calling for a board of competent naval architects is not original in this connection, as will be seen by the following recommendation contained in the annual report of the Supervising Inspector General for the fiscal year just closed, the first paragraph of which appeared also in his annual report for the fiscal year ended June 30, 1914:

> There should be stationed in the office of the Supervising Inspector General a corps of experts whose business it would be to approve the proposed hull construction. This, it is thought, is necessary (1) because it would enable the Department to employ experts who are more familiar with hull construction than the local inspectors, and (2) it would result in that uniform administration of the law with which the Supervising Inspector General is charged.
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> It is very essential also that there be a larger number of boiler inspectors, for under present conditions there are many repairs that are being made to boilers that are not followed up, because there is not a sufficiently large force of boiler inspectors to examine these repairs. Anyone who is familiar with boiler-repair work of the present day knows that the use of oxy-acetelene welding is being rapidly extended, and this work should be carefully followed up by the inspectors. It is not so much that there is danger in welding under certain conditions as that the workman who does the welding is not qualified to do it, and there should be a sufficiently large force of boiler inspectors to keep in touch with this work.

The recommendation contained in the first paragraph quoted above was approved in my report for the fiscal year ended June 30, 1914 (p. 173). It was then pointed out by me that "it would be a distinct departure from the principles that have heretofore governed the Steamboat-Inspection Service in the matter of the jurisdiction of local inspectors." This departure I now recommend in accordance with the statement of the Chicago board of inquiry. However, it should be borne in mind that this would require a much larger appropriation than at present, not only to pay the salaries of the experts employed but those of the additional clerks required. I also renew the recommendation made in my last report that "all boilers used on vessels subject to inspection shall first be approved by experts in the office of the Supervising Inspector General. * * * The law should therefore be changed so as to require the approval by the Supervising Inspector General of the design of these boilers."

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It is also recommended that section 4433, Revised Statutes, be amended so as to provide that every boiler hereafter constructed of plates inspected as required by Title LII shall be allowed a working steam pressure as determined by the rules of the Board of Supervising Inspectors. The enactment of a statute containing such a provision would give to the Board of Supervising Inspectors that discretionary authority for arranging for boiler construction that it should possess if it is to make its rules meet the best modern practice.

Proposed Legislation Affecting Motor Boats.

A bill to provide for the numbering of motor boats, which has been prepared with the approval of the chief motor-boat interests after full discussion of the matter with them, will be submitted to Congress for enactment. Under the present law there is no authority to restrict the number of passengers that may be carried on vessels other than steam vessels, and for the purpose of correcting this condition it has been proposed that section 4464, Revised Statutes, be amended to read as follows:

SEC. 4464. The inspectors shall state in every certificate of inspection granted to vessels carrying passengers, other than ferryboats, the number of passengers of each class that any such vessel has accommodations for and can carry with prudence and safety.

It will be noted that the desire is to substitute the word "vessel" for "steamer."

Under present conditions the situation, as concerns motor vessels, is partly met by their equipment—that is to say, the vessels are boated according to the number of persons they carry—but it must be obvious to anyone that this is an attempt to control a dangerous situation by indirect methods, which are never satisfactory. Is it necessary that in order to eliminate the danger of carrying too many persons on motor boats there shall be some great catastrophe? In the light of the past, why is it necessary that this lesson should be brought home at such cost? Attention is called to this matter so that proper legislation to correct this very dangerous condition may be considered by Congress.

It is earnestly recommended that legislation be provided to require that every licensed operator of motor boats shall be able to read and write, shall not be color blind, and shall understand the pilot rules. Reference is made to accident report No. 69516, February 3, 1915, concerning the passenger motor boat *Erna M. Lucas*, and to accident report No. 70162, March 2, 1915, accident

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to passenger motor boat *Leader*, both of which are on file in this Department, as illustrating the necessity for legislation in the matter of motor boats.

Fireproof Excursion Steamers.

Repeatedly heretofore the Supervising Inspector General has urged that passenger excursion steamers should be constructed of fireproof materials. Reviewing the record of the recommendations to this effect in his report for the fiscal year just closed, the Supervising Inspector General states that "the best way is to remove the cause for such a disaster (referring to the burning of the steamer *General Slocum*) and require absolute fireproof construction of excursion steamers. This can not be done until Congress acts, and the Bureau most earnestly invites attention to the necessity for legislation in this respect."

This matter was treated on page 174 of my report for the fiscal year ended June 30, 1914. I concur in and urge the adoption of the suggestion of the Supervising Inspector General recommending that legislation be enacted to provide that on and after January 1, 1918, passenger excursion steamers carrying 250 passengers or more shall be constructed of strictly fireproof materials.

It is no longer open to doubt that such construction is feasible. The matter has long passed its experimental stage. On November 22, 1906, an address was made by William Gatewood, Esq., before the Society of Naval Architects and Marine Engineers at New York giving particulars of an adaptation of fireproof construction to the excursion steamer *Jamestown*, built by the Newport News Shipbuilding & Dry Dock Co. for the Norfolk & Washington Steamboat Co. The address is accompanied by plans and drawings showing details of construction. It is on file in the library of this Department. Reference may be made in this connection to accident report No. 69984 on the burning of the passenger steamer *Maryland* in Chesapeake Bay, on January 22, 1915. On this occasion the skill of the captain, officers, and crew saved every life on board, but the warning is none the less obvious.

Overloading of Passenger Steamers.

Closely connected with the construction of passenger steamers is the matter of the possible overloading of passenger steamers in use. In the matter of passenger allowances the original responsibility is placed by law upon the local inspectors. A further safeguard in this direction is proposed among the recommendations of the Chi-

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cago board of inquiry above quoted. The Department would be glad if every ship carrying passengers could be measured and tested by experts to determine what the passenger allowance of these vessels should be, but it is impossible to do this under the present provisions of the law. Every effort has been made to impress upon the local inspectors the seriousness of the responsibility which in this respect rests upon them. In the absence of sufficient clerical help and of a sufficient number of inspectors, the Department has been and is seriously concerned lest this vital matter may not always receive the mature and deliberate care it merits and which the public properly expect it to receive. Until, however, the means shall be provided to do this work as it ought to be done, it may in some places be done as it ought not to be done. It is too serious a matter to be done in a hurry, amid the interruptions of inspecting hulls and boilers, examining candidates for licenses, looking after details of equipment, and all the other mass of current business that crowds itself upon a board of local inspectors. If this work is worth doing at all, it is worth doing well, and it is not always certain to be well done if it is done as an incident to an overcrowded day. The inspectors are held to strict account and will continue so to be; but the equity of expecting them to do this or other work as it ought to be done when the conditions are known to be such that they can not so do it is seriously open to question.

Apart from the question of the propriety of greater passenger allowances, the further question whether a steamer carries more passengers than her certificate of inspection permits her to carry demands attention. It is believed that violations of this rule are rare. Statements of excessive loading on the part of spectators are almost never accurate. They usually vary by many hundreds from the facts. Such statements are almost never based upon any actual count or upon any other real attempt to get the truth. They are at best but guesses, usually grotesquely large. The new force of navigation inspectors who under the Bureau of Navigation check the loadings of passenger steamers with mechanical counters are doing their work well and in such a way as to make loading beyond the certificate number a very difficult matter.

Transportation of Dangerous Articles.

In connection with the danger of fire on shipboard is to be considered also the question of the transportation of dangerous articles. The fact is that section 4472, Revised Statutes, which

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has been repeatedly amended, does not commence to meet modern conditions. It is possible to-day to transport dangerous articles on steamers carrying passengers that are not "like dangerous articles" to those that are referred to in section 4472, Revised Statutes, and over such a situation as this the Department has no control. Furthermore, the Department has no control over the transportation of dangerous articles on freight steamers, notwithstanding the fact that the lives of persons traveling on passenger steamers may be jeopardized as a result of careless methods followed on freight steamers.

There should be conferred upon the office of the Supervising Inspector General authority to regulate this very dangerous practice. It is, of course, to be borne in mind that the purpose of the Department is not to destroy, but to regulate, commerce, and therefore there are some commodities which if regulated might be transported with comparative safety on steamers carrying passengers, but the regulation of which can not now be undertaken because the Department is without authority to do so.

Here again conditions exist for which the Service is not responsible and which it now and here asks power to remedy.

"Monroe-Nantucket" Disaster.

On February 2, 1914, the following letter was sent to the Commissioner of Navigation:

You are hereby constituted a special committee of this Department, together with Hon. George Uhler, Supervising Inspector General, Steamboat-Inspection Service, to inquire into and consider all facts which have heretofore been brought out in evidence, or which may hereafter be so developed, together with such other circumstances as may be available, in relation to the collision between the steamships *Monroe* and *Nantucket* on the morning of January 30, 1914, with the view of making to the Secretary of Commerce such suggestions as may arise from your study of all the facts forming the environment of this accident, and having bearing upon further securing safety of life at sea.

Your suggestions are invited as to improved action on the part of the Department or any of its bureaus, or as to legislation that should arise in your judgment out of the lessons to be learned from this disaster. Your action is entirely distinct and separate from the regular procedure provided for by law and now in the hands of the local boards of inspectors at Norfolk and Philadelphia. You will take into account the testimony adduced before such boards and will make such other inquiry into the whole subject as is practicable. The local boards will deal with the question of responsibility on the part of the officers of the vessels concerned in the accident. You will deal with the larger questions of the lessons to be learned from it.

The report of the committee thus formed, though not received until October 16, 1915, has bearing upon the work of the fiscal year now being discussed and is therefore printed in full on succeeding pages.

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OCTOBER 16, 1915.

Hon. WILLIAM C. REDFIELD,
Secretary of Commerce.

SIR: Complying with the instructions of your letter of February 2, 1914, I have read attentively all the typewritten evidence taken at Philadelphia at the investigation of the master of the steamship *Nantucket*, and I attended the investigation at Baltimore of the master of the steamship *Monroe*. The following suggestions are offered:

COURTS OF INQUIRY.

1. A tribunal should be lawfully established for investigations into marine casualties involving serious loss of life, similar generally to the courts of inquiry provided for in the British merchant shipping act and the Canadian merchant shipping act. The need of such a tribunal was shown after the burning of the steamship *General Slocum* in 1904, the capsizing of the steamship *Eastland* this year, and after several serious disasters in the years intervening. The Secretary of Commerce on all of these occasions has recognized that the gravity of the calamity demanded an investigation other than the usual investigation by the board of local inspectors. The special committees or commissions appointed on these occasions have had no legal standing, no lawful power to subpœna and examine witnesses, or to perform those acts necessary to conduct an investigation. Under the authority bestowed by your letter of February 2, 1914, I did not feel at liberty to ask questions at the Baltimore inquiry, as I feared such interruption might invalidate the proceedings. The situation pointed out will continue until Congress bestows upon the Secretary of Commerce powers similar to those enjoyed by the President of the Board of Trade under the British merchant shipping act

PENALTIES FOR VIOLATING THE INTERNATIONAL RULES OF THE ROAD.

2. For obvious reasons the international regulations for preventing collisions at sea do not contain in themselves specific penalties for violations. Each nation imposes on its own vessels the penalties it sees fit. As the rules, however, govern the courts in determining the vessel or vessels at fault in cases of collision, etc., they in effect carry a penalty in damages when violation results in loss. In the United States a licensed officer who has violated the rules is subject to trial by the local inspectors, and if found guilty is subject to the revocation or suspension of his license, the former penalty amounting to depriving him of his calling and occupation. Furthermore, under section 4493 of the Revised Statutes, "any person sustaining loss, or injury through the carelessness, negligence, or willful misconduct of any master, mate, engineer, or pilot, or his neglect or refusal to obey the laws governing the navigation of such steamers, may sue such master, mate, engineer, or pilot, and recover damages for any such injury caused by any such master, mate, engineer, or pilot."

The British law in serious cases is more severe. Sections 419 and 680 of the merchant shipping act provide:

"419.—(1) All owners and masters of ships shall obey the collision regulations, and shall not carry or exhibit any other lights, or use any other fog signals, than such as are required by those regulations.

"(2) If an infringement of the collision regulations is caused by the wilful default of the master or owner of the ship, that master or owner shall, in respect of each offense be guilty of a misdemeanor.

"(3) If any damage to person or property arises from the nonobservance by any ship of any of the collision regulations, the damage shall be deemed to have been occasioned by the wilful default of the person in charge of the deck of the ship at the time, unless it is shown to the satisfaction of the court that the circumstances of the case made a departure from the regulation necessary.

"(4) Where in case of collision it is proved to the court before whom the case is tried, that any of the collision regulations have been infringed, the ship by which the regu-

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lation has been infringed shall be deemed to be in fault, unless it is shown to the satisfaction of the court that the circumstances of the case made departure from the regulation necessary * * *

"680.—(1) Subject to any special provisions of this Act and to the provisions hereinafter contained with respect to Scotland—

"(a) an offense under this Act declared to be a misdemeanor, shall be punishable by fine or by imprisonment not exceeding two years, with or without hard labour, but may, instead of being prosecuted as a misdemeanor, be prosecuted summarily in manner provided by the Summary Jurisdiction Acts, and if so prosecuted shall be punishable only with imprisonment for a term not exceeding six months, with or without hard labour, or with a fine not exceeding one hundred pounds.

"(b) an offense under this Act made punishable with imprisonment for any term not exceeding six months, with or without hard labour, or by a fine not exceeding one hundred pounds, shall be prosecuted summarily in manner provided by the Summary Jurisdiction Acts."

DECK OFFICERS.

3. When a large ocean passenger steamship is under way in a fog or in crowded waters where there is risk of collision, at least two officers should be on watch on the bridge continuously without even a few moments' break in this double watch. This is desirable for the safe navigation of the ship and the avoidance of collision, and is imperative in the event of a collision in view of the many duties in respect of his passengers as well as of his crew and ship which the master instantly must perform. Electrical and mechanical appliances for safety on shipboard, controlled from the bridge, enable a master to act more promptly and effectively than formerly, but they render the presence of two trained officers familiar with such appliances the more necessary.

During the very few moments which elapsed between the time when those on the steamship *Monroe* first learned of the proximity of the steamship *Nantucket* and the actual collision, at the time when the ships came together and remained briefly together, and for several moments afterwards, the master of the steamship *Monroe* was alone on watch. The other watch officer had been allowed to go to the toilet room nearby, and another officer had not been called temporarily to his place, although the ship had been slowed down apparently on account of thickening fog, in itself evidence of increasing risk.

Such a situation should not be repeated. The act of March 3, 1913, dealt with the subject of licensed mates, but the hearings and reports show, it seems to me, that the hours of labor of these officers were under consideration, rather than the safety of ocean passengers. Ocean passenger and cargo steamers and ocean tugs were treated in the same manner on a tonnage basis. A licensed deck officer in time of accident on an ocean passenger steamship has all the duties to perform which must be performed by such officer on a cargo boat, and in addition urgent duties in respect of the passengers. You are familiar with the difficulties which the Department has found in enforcing the act of March 3, 1913, known as the "three-mates law." It certainly does not in terms meet the situation presented by the *Monroe-Nantucket* collision.

HULL CONSTRUCTION.

4. The provisions of Chapter IV, Construction, of the International Convention on Safety of Life at Sea, should be enacted into law and made applicable to American ships at a date in the future sufficiently removed to give those concerned reasonable opportunity to conform to the requirements. In the meantime, an adequate appropriation should be asked for to conduct through a skilled committee (preferably chosen from the Society of Naval Architects and Marine Engineers, working with the Supervising Inspector General of Steam Vessels), the investigations provided for in article 30 of the international convention.

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GENERAL.

5. The matters of an emergency lighting system for boat decks, of self-igniting water lights in lifeboats—both of which would have been serviceable on the steamship *Monroe* immediately after the collision—have already been taken up by the Steamboat-Inspection Service. The Coast and Geodetic Survey and the Lighthouse Bureau are considering changes in the position of certain lightships, with a view to establishing, if feasible, ocean tracks for coastwise steamers north of the Chesapeake capes.

I have spoken to you of the desirability of experiments by the Bureau of Standards in the matters of directive radio communication, and the utility of submarine signals.

Respectfully,

E. T. CHAMBERLAIN, *Commissioner.*

I concur:

GEO. UHLER, *Supervising Inspector General.*

Attention is especially directed to the court of inquiry which is suggested in the above report. On November 13, 1913, a serious storm occurred in portions of the Great Lakes, causing enormous marine disasters. On September 29, 1915, a hurricane prevailed in the lower Mississippi Valley, causing enormous wrecks and a considerable loss of life. This storm was preceded by one of at least equal severity off the coast of Texas. It is not possible for the Steamboat-Inspection Service with the force and funds at its command to investigate these disasters with the painstaking care the law contemplates. For this cause the lessons that may often be learned from the thoughtful study of such disasters, as to the conduct of officers, and as to the nature and quality of vessels, are not learned. The disaster comes and goes and we are little or no wiser by reason of the lesson it teaches. In such a case as the *Monroe-Nantucket* the inquiring body must sit for a continued period. In the case of the hurricanes mentioned the inquiry would have to cover the loss of many ships over wide areas. Officers can not do this well whose days are crowded full of demands for inspection, for examining officers—for a hundred other details required of the steamboat inspectors. The recommendation therefore that a board of inquiry be created to specially study disasters involving serious loss of life or unusual loss to shipping has been approved and legislation will be introduced at the next session of Congress providing for the creation of such board. The further recommendations in the foregoing report are commended to the serious attention of the Congress.

Summary of Proposed Legislation.

I may sum up the further legislation requisite to permit the Steamboat-Inspection Service to carry out its own high ideals of public safety by stating that after the necessary increase of force

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and funds requisite both in the office and field in order to permit the work to be as well done as it ought to be these further matters are required:

The enactment into law of the recommendations made by the board of inquiry at Chicago following the *Eastland* disaster.

The enactment of a law requiring fireproof construction of all excursion steamers after January 1, 1918, as previously noted.

The amendment of sections 4417 and 4418, Revised Statutes of the United States, so as to relieve local inspectors of original jurisdiction in the matter of hull and boiler construction, placing the responsibility for this work on the office of the Supervising Inspector General, providing that office with the necessary expert assistance for the purpose.

The division of the first inspection district into two, as heretofore explained.

The enactment of a law providing for the numbering of motor boats and for the proper qualifications for licensed operators thereof.

The amendment of section 4433, Revised Statutes, to provide that the working pressure allowed steam boilers may be determined by the rules of the Board of Supervising Inspectors in order to enable that board to make rules with reference to boiler pressure that are consistent with the best modern practice.

The amendment of section 4464, Revised Statutes, to enable inspectors to control the number of persons that travel on motor boats as passengers and also the number of persons who travel on ferry boats as passengers. Under present conditions dangerous situations may arise that can not be controlled under the present law.

The amendment of section 4472, Revised Statutes, so as to give the Steamboat-Inspection Service authority to better control the transportation of dangerous articles.

The amendment of the law with reference to the appointment of assistant inspectors so that instead of appointing same to certain ports and detailing them to other ports as at present they may be appointed to the port where they are actually to serve.

It is possible that after all accounts are balanced for the fiscal year ended June 30, 1915, there may be turned back into the Treasury a small amount, perhaps $2,000, on account of the contingent expenses of the Steamboat-Inspection Service. The question may naturally arise why this was not spent in making reinspections. The reason is that the Bureau can not take chances of a

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deficit, because there may occur some accident or disaster requiring immediate investigation at considerable expense and the Service can not take the risk of being without funds with which to give such matters prompt attention. The only way possible to secure these funds under present circumstances is by stopping certain necessary work when the danger point seems reached.

It would illustrate how unforeseen yet proper demands may suddenly arise to state that on June 29 three inspectors had to be called from the field (New England and New York) to Washington in connection with the demand for a certificate for the steamer *Lansing*, which vessel was found unseaworthy by several inspectors. In like manner the inquiry following the disaster to the *Eastland* required bringing from Cleveland to Chicago, from Grand Haven to Chicago, as well as from Milwaukee and Detroit to Chicago, six officers of the Service who were needed in connection with the inquiry.

I have spoken with great frankness on the subject of the Steamboat-Inspection Service because I feel very keenly the unjust attacks which are made upon it. I have made it my duty, as it is a privilege, to become personally acquainted with the officers of the Service, of various ranks, from one end of the country to the other and from the Lakes to the Gulf. I am speaking of men whom I personally know and whose work I have seen in saying that the work of the Steamboat-Inspection Service is as a whole admirably well done. The record shows that officers of that Service who are derelict are sharply brought to account and that breaches of discipline and negligence of duty are not tolerated. The spirit of the Service is admirable, and the material which composes it is of the best. No voice is lifted to suggest that improper influences of any nature are successfully exerted upon it. It has a keen sense of its high mission in safeguarding the lives of the 300,000,000 passengers who yearly travel on the vessels under its care. The vast majority of such complaints as are made respecting the Service say that it is too severe. It is only when some serious accident occurs that the public, knowing nothing of the limited force and the narrow means with which the Service must needs work, conscious only that sad harm has come and that there is a force charged by law with the duty of safeguarding life, assumes the Service to have been careless and listens, to say the least, with most reluctant ear to the facts in the case.

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It is at such times prone to forget that the Steamboat-Inspection Service can not at its best remove the heavy responsibility that rests upon the licensed officers of ships. Let the inspectors do their utmost, they are not responsible in any degree for the navigation of a vessel, nor can they be held accountable for the mistakes of the officers of the ship.

The Nation wishes the work of its Steamboat-Inspection Service well done, but it can not be well done unless the Nation provides enough men and money to do it well. That is not now done. If and when it shall be done there will, humanly speaking, be little or no occasion for complaint of the effectiveness of the Steamboat-Inspection Service.

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BUREAU OF NAVIGATION.

Added Responsibilities of the Commissioner of Navigation.

As is explained in detail in the following pages, Congress has imposed serious additional duties in recent years upon this service, of which three examples which all will remember are the ship-registry act, the seamen's act, and the supervision of the Radio Service throughout the country. The Commissioner of Navigation, however, has been given no added compensation for these serious additions to his responsibility, nor has he been allowed any additional force with which to do the greater work. It is an act of simple justice that his salary under the onerous conditions now imposed by law upon his Bureau should be made equal to that which others similarly situated receive. I shall therefore include in the estimates for the coming year an increase in the salary of the Commissioner of Navigation from $4,000 to $5,000. One has but to read the annual report of that service to see that it is readily earned, two whole forces of men not in existence when the present compensation was fixed having since been placed under his direction, viz, the Radio Service and the navigation inspectors.

Increase in American Merchant Marine.

The merchant ships of the United States registered for the foreign trade on June 30, 1915, numbered 2,794 of 1,871,543 gross tons, an increase of 389 vessels and 795,391 gross tons during the year. The one other fact in the history of our merchant marine, comparable in significance to this increase, was the decrease of 709,357 gross tons of American ships in foreign trade between June 30, 1862, and June 30, 1864. Our gain in the ten months following the passage of the ship-registry act of August 18, 1914, has been absolutely and relatively greater than our loss during the two darkest years of the Civil War. Our tonnage for foreign trade is now greater than at any time since 1863.

A year ago maritime nations in the order of their importance in the foreign carrying trade of the world ranked as follows: Great Britain, Germany, Norway, France, Japan, Italy, Netherlands, Sweden, United States. In the year the United States has outstripped Sweden, the Netherlands, and Italy, and drawn up even with Japan. So large a proportion of French ships are employed for military purposes that the difference between the

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tonnage of American and French ships in foreign trade can not be very great. While merchant shipping under the British flag conducts about half of the world's carrying trade, the American increase in tonnage during the past year has been greater than the average annual increase of the British Empire during the ten years up to June, 1914, which was 403,000 tons.

The following statement from Lloyd's Register for June 30, 1915, the best authority on maritime statistics available at the moment, shows the changes which have taken place during the year of the war (1914–15), and during the preceding peaceful and prosperous year (1913–14), the figures dealing only with vessels over 100 gross tons, and in the case of the United States including our larger Lake vessels but not those employed on our numerous river systems:

Nationality.	1913	1914	Change from 1913.	1915	Change from 1914.
	Gross tons.	*Gross tons.*	*Gross tons.*	*Gross tons.*	*Gross tons.*
American	5,427,636	5,368,194	− 59,442	5,892,639	+524,445
British	20,431,543	21,045,049	+ 603,506	21,274,068	+229,019
German	5,082,061	5,459,296	+ 377,235	4,706,027	−753,269
Norwegian	2,457,890	2,504,722	+ 46,832	2,529,188	+ 24,466
French	2,201,164	2,319,438	+ 118,274	2,285,728	− 33,710
Japanese	1,500,014	1,708,386	+ 208,372	1,826,068	+117,682
Italian	1,521,942	1,668,296	+ 146,354	1,736,545	+ 68,249
Dutch	1,309,849	1,496,455	+ 186,606	1,522,547	+ 26,092
Swedish	1,047,270	1,118,086	+ 70,816	1,122,883	+ 4,797
Other countries	5,990,744	6,401,630	+ 410,894	6,366,076	− 35,554
The world	46,970,113	49,089,552	+2,119,449	49,261,769	+172,217

Ship-Registry Act of 1914.

By far the greater part of the increase in American tonnage shown above is due to the ship-registry act of August 18, 1914. That act went into practical operation a few days after the order of the President of the United States of September 4, 1914, suspending in the case of ships registered under the act certain requirements of law. In the 10 months following that date up to the close of the fiscal year on June 30, 1915, American registers were issued to 148 vessels of 523,361 gross tons (338,354 net tons, equivalent to about 800,000 tons dead-weight capacity), and manned by 6,149 men, including masters. The value of the steam vessels registered was $32,445,786, and of the sail vessels $946,970, a total of $33,392,756. This amount is considerably less than the amount the ships would have brought if purchased in the open market at prices obtaining during the greater part of the year. Nearly all these ships were owned by Americans long before the outbreak of

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the European war, and the values given are those at which the ships were carried on the books of the owners. In very few cases was there an actual bargain between buyer and seller. Of these ships, 96, of 332,258 gross tons, were formerly under the British flag; 30, of 147,742 gross tons, under the German flag; 5, of 17,401 gross tons, under the Cuban flag; 6, of 10,549 gross tons, under the Belgian flag; 5, of 5,452 gross tons, under the Mexican flag; 1, of 5,275 gross tons, under the Roumanian flag; 1, of 1,352 gross tons, under the Uruguayan flag; 1, of 1,381 gross tons, under the Chilean flag; and 2, of 1,349 gross tons, under the Norwegian flag; 1 yacht, of 602 gross tons, was owned by an American but without documents.

These 148 vessels stand in the names of 63 different owners, the Standard Oil Co. owning 25, of 130,322 gross tons; the United Fruit Co. 24, of 113,243 gross tons; and the United States Steel Products Co. 10, of 48,271 gross tons, while 44 individuals or corporations own but a single ship. The additions to our fleet from this source include 109 steamships of 478,704 gross tons, of which 45 were cargo steamers of 165,565 gross tons, 37 tank steamers of 181,670 gross tons, and 27 passenger steamers of 131,469 gross tons. There were 35 sail vessels of 43,210 gross tons, of which 24 were square-rigged ships or barks aggregating 34,708 gross tons. Four yachts of 1,447 tons were also registered. Five of the vessels registered, aggregating 10,421 gross tons, were lost, however, before the close of the year, so that the actual increase in our shipping in foreign trade under the ship-registry act was 143 vessels of 512,940 gross tons.

Total American Merchant Marine.

The increase of 736,623 gross tons in American shipping in foreign trade comes in part also from the diversion of our ships, formerly in domestic trade, to the foreign trade through the more favorable conditions for competitive employment created by the European war. Indeed, the total increase during the year of American shipping of all kinds, employed in the foreign or domestic trade, was only 460,741 gross tons. This increase, however, is greater than for any previous year in our history. On June 30, 1915, the total documented American shipping comprised 26,701 vessels of 8,389,429 gross tons, compared with 26,943 vessels of 7,928,688 gross tons on June 30, 1914. This merchant fleet, second only to that under the British flag, comprises 6,952 steam vessels of 5,781,416 gross tons, 5,866 sail vessels of 1,384,474 gross tons, 4,327 barges of 999,166 gross tons, 8,996 documented motor

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vessels of 162,394 gross tons, and 560 documented canal boats of 61,979 gross tons.

The Census Bureau in 1906 estimated the value of all vessels of the United States, including those not required by acts of Congress to be documented, at $508,000,000. Assuming that valuation to be approximately correct, the value of all American vessels at the present time doubtless exceeds $600,000,000, of which fully $100,000,000 is invested in ships in foreign trade.

Shipbuilding.

The output of our shipyards on the seaboard for the fiscal year ended June 30, 1915—866 vessels of 203,156 tons—was a third less than during the fiscal year 1914, and less, indeed, than for any year of the past 16. This diminished output was anticipated at the outset of the fiscal year on account of the temporarily depressed condition of industry and on account of the temporary diminution of shipbuilding in other countries.

The current fiscal year opens with the prospect of a very large output at home. The conditions in the shipbuilding industry created by the outbreak of the European war were not fully appreciated here until late in the autumn. Contracts were made in the autumn months and in the early months of 1915 which will secure to our shipyards full employment throughout the current fiscal year. On July 1, 1915, our shipyards had under construction or under contract 62 steel vessels of 294,138 tons, the largest volume of work of this description on record. The total for the year will doubtless be about 400,000 tons. The shipyards on the Great Lakes, however, had at the close of the fiscal year relatively little new work, and for this reason the output for the entire country may not equal some of the record years in our comparatively recent history. Half of the tonnage mentioned now under construction or contract is made up of steamers specially built to carry oil in bulk. It is to be noted also that a third of the tonnage brought under the American flag by the ship-registry act of 1914 consisted of vessels of the same type, and of the larger steamers built in the country last year one-third of the tonnage was also tank steamers.

Navigation Receipts.

The receipts from tonnage duties last year were $1,315,425.30, compared with $1,310,759.03 for the previous year, and are the largest annual receipts from this source in over 30 years. The slight increase over the fiscal year 1914 was not looked for, as

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it was generally expected that receipts from this source would be considerably reduced in consequence of diminished foreign trade owing to the European war. Again, by modifications in the measurement regulations, reducing somewhat net tonnage on which these duties are levied, a further diminution of receipts had been expected. Marked changes, of course, have taken place in the nationalities and types of the ocean carriers of our foreign commerce. The following table shows concisely the share of tonnage taxes paid by vessels under the American flag for the two years, under other neutral flags, and under the flags of the six allied nations on the one hand and the Austro-Hungarian and German flags on the other:

	1914	1915	Increase (+) or decrease (−).
American	$77,445.06	$104,736.73	+$27,291.67
Other neutrals	147,106.18	267,821.04	+120,714.86
Belgian, British, French, Italian, Japanese, and Russian	875,737.20	914,063.95	+ 38,326.75
Austro-Hungarian and German	210,470.59	28,803.58	−181,667.01
Total	1,310,759.03	1,315,425.30	+ 4,666.27

Tonnage duties are levied on five voyages a year at the rate of 6 cents per net ton on vessels arriving from oversea ports and 2 cents on vessels arriving from ports of North America, Central America, Mexico, and the West Indies. The large and fast trans-Atlantic passenger liners make 10 or 12 voyages a year, and all entries after the fifth are exempt from tonnage duties. Many of these large steamers have been withdrawn from regular service and employed as transports to carry the troops and reservists from all parts of the world to the several scenes of military operations. These steamers in ordinary times are employed chiefly in the transportation of immigrants and hundreds of thousands of those who cross the oceans for pleasure. Immigration and pleasure travel have been very greatly reduced. Military necessity and changed trade conditions have thus withdrawn these fast passenger ships and their places have been supplied to a very great extent by slow cargo steamers, and even by sailing vessels. These vessels make fewer voyages during a year, and, accordingly, pay tonnage duties on every entry, or nearly every entry. The same conditions, so far as can now be foreseen, are likely to continue throughout the current fiscal year, and in that event there will be no reason for a material change in the receipts from tonnage duties during the current year. Our rates of tonnage duties are as a rule less than the

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corresponding charges levied in the ports of South America, Europe, Asia, and Africa, and I wish again to emphasize the fact that "these duties are imposed without discrimination on vessels of the United States and vessels of foreign nations under reciprocal treaties entitled to equal treatment with vessels of the United States, and, consequently, are in no sense a handicap on American shipping."

The receipts from navigation fees for the year amounted to $142,446.37, a decrease of $10,247.82 compared with last year. The cost of collecting these fees is relatively large, and, as stated in this report last year, the Department will favor the abolition of the fees whenever a reduction of the revenues may be practicable.

The collections from navigation fines during the year amounted to $41,518.24, an increase of $776.86 over last year. The working, thus far, of the agencies which Congress has placed at the command of the Department during the current fiscal year indicates an increase in receipts this year from this source.

The receipts from the three sources named aggregate $1,499,389.91, a decrease of $4,804.69 compared with last year. In addition to these annual revenues the sum of $37,976.30 was collected during the year under section 37 of the tariff act of 1899 imposing an excise upon foreign-built yachts owned by Americans. This is an extraordinary receipt and represents the principal and interest collected under the decision of the Supreme Court of the United States in the case of Billings *v.* The United States (232 U.S., 261). The law imposing this tax was repealed by the tariff act of October 3, 1913, and only a few cases remain to be settled.

The total cost of maintaining the Bureau of Navigation for the fiscal year ended June 30, 1915, was $187,030. It will therefore be seen that the receipts collected under the general supervision of this service and those arising from its operations are more than eight times greater than the total cost of maintaining the service. The work of the Bureau of Navigation has enormously increased within the last year because Congress through legislation has imposed serious and burdensome duties upon it without allowing any greater compensation or any additional force. The clerical staff is the same in number to-day as it was in 1884. There have recently been imposed upon it by law the supervision of the Radio Service, the supervision of motor boats, the counting of passengers upon excursion vessels, the ship-registry act, and the seamen's act, in addition to the enforcing of the navigation laws upon hundreds of thousands of small vessels all over the country. To this the consideration of questions in connection with the admeasurement

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of vessels for the Panama Canal should be added. It is literally impossible to carry out these laws with the present force, which is totally inadequate to perform the services required by law. Therefore the estimates for the coming year will show an addition to the clerical force, not as a thing to be desired but as a matter of necessity without which the work can not be done. The increase in the work of this service has not arisen of its own motion, but has been imposed upon it from without by the will of Congress. It is the desire of the service to carry out this will, but it can not do it with the means and the men now provided.

Shipping Commissioners.

Shipping commissioners at 15 seaports shipped, reshipped, and discharged during the year 414,744 seamen on vessels of the United States, an increase of 35,972 compared with the previous year. The amount of salaries was $63,755.47, an increase of $280.27. The number of men shipped, reshipped, and discharged at New York was 247,833, an increase of 43,486 over last year, and at New Orleans 27,687, an increase of 16,121 over last year. At San Francisco, however, the number was only 29,285, a decrease of 25,093. Last year the estimates provided for additional clerks at New York and New Orleans, and the recommendation is earnestly renewed. Before any new shipping commissioners' offices are established it would be well to man those we already have with a force sufficient to perform the necessary work. Various makeshifts at present have to be resorted to to enable the New York and New Orleans offices to meet the large increase in work resulting from the ship-registry act of August 18, 1914.

The returns of shipping commissioners give an approximate idea of the nationality of the men who compose the crews of our merchant ships. These returns are based on shipments during the year, and when, as is usually the case, the same seaman ships for several voyages before a commissioner he is counted each time in the returns. Bearing this in mind, of the 218,541 men reported shipped 65,196 were native-born Americans, 29,965 naturalized Americans, 29,395 British subjects, 25,252 Spaniards, and 21,853 Norwegians, Swedes, and Danes. The remainder is made up of men of various nationalities from all parts of the world. These figures, it may be added, do not include seamen shipped on American ships abroad before consuls. Of such, 6,233, mainly Asiatics, were shipped at Hongkong and 9,106 at Liverpool and Southampton, England, for the American Line and Red Star Line steamers, nearly all of whom were British subjects.

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When I appeared with the Commissioner of Navigation before the Appropriations Committee of the Sixty-third Congress at its third session, I was obliged to tell them the plain truth, to the effect that the contingent appropriation for the Bureau of Navigation was not sufficient to pay the ordinary running expenses for that service, and to say further that unless they could increase the appropriation for the coming fiscal year it would be necessary to drop some of the offices in cities where shipping commissioners were located. The contingent fund was not increased and the appropriation was omitted for the offices of the shipping commissioners at Bath, Me., Gloucester, Mass., and Pascagoula, Miss., which offices were accordingly closed at the opening of the fiscal year.

Radio Communication.

The work of the Bureau of Navigation in enforcing the two acts relating to radio communication and the international convention has been materially extended. The radio inspectors conducted their work at 74 places, and the system of radio inspection may now be said to have been fairly established through the country, though it has not yet been possible to inspect the Alaska stations. The number of ship inspections this year was 6,155, compared with 6,484 for the previous year, the decrease being due to the fact that smaller ships not required to carry wireless apparatus have taken the place during the European war of larger ships subject to inspection. The number of land stations inspected was 560, compared with 368 for the previous year, and the number of operators examined as to qualifications was 3,194, compared with 2,245 in 1914. The total number of stations licensed was 4,039, compared with 2,309 during the previous year, and the total number of licenses issued to operators was 4,859, compared with 1,548 in 1914. The total number of operators licensed, including amateurs, is 10,973. The voluntary and statutory use of radiotelegraphy, as I stated last year, is increasing rapidly, and a moderate annual increase in the appropriation is needed. It is particularly gratifying to be able to state that in all instances of marine casualties in which wireless telegraphy could play a part the apparatus subjected to inspection by the Department's service performed its work satisfactorily both as to the main set and as to the auxiliary power, which is of growing importance. Incomplete records, which the Department has now begun to assemble, show 36 marine casualties during the year in which the wireless system on ships inspected by the Department contributed to the saving of life and property. The

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wireless service on shipboard is relatively new, and the highest standards of fearlessness and devotion to duty established from the beginning are commendable. During the year the Department has started the organization of a corps d'elite among operators of specially high qualifications, to which a special license is awarded. It now numbers 21.

Enforcement of Navigation Laws.

This work has continued throughout the year with steadily increasing efficiency. During the fiscal year 1915, 6,860 violations of the navigation laws were reported to the Department for action, as compared with 6,720 for the fiscal year 1914.

During the summer of 1914 the motor boat *Tarragon* continued the work of inspection along the entire New England coast and as far south as the North Carolina sounds. On the opening of the oyster season close attention was given to the oyster fleet and the improvement of the condition of the 3,500 men employed on those vessels. It was discovered that the practice of putting the men ashore after the season had closed without the full payment of their wages was increasing. The difficulty of securing service on the masters of these vessels was such that it became necessary to appoint the commander of the *Tarragon* a deputy United States marshal for all the districts bordering on Chesapeake Bay and the North Carolina sounds. Vigorous action was taken, and complaints of this nature have now practically ceased.

During the year the Department purchased the motor boat *Dixie*, a stanch, serviceable vessel of 52 gross tons having a speed of about 15 miles an hour. This vessel is a little larger than the *Tarragon*, which was found too small for securing the best results in New England waters. This vessel did not go into commission, however, until July 1, 1915. She will operate in New England waters during the summer and in southern waters during the winter.

It is believed that with these two vessels, supplemented by the occasional hire of motor boats by collectors of customs, a systematic inspection may be made of the entire Atlantic coast.

The work of these vessels is not confined to motor boats. Their crews are constantly employed in the general supervision of the equipment and navigation of vessels of all sizes in Atlantic coast waters.

It is proposed during the coming year to install a first-class wireless equipment on the *Dixie*, in order that her work also may extend to the testing and inspection of wireless apparatus on steamers carrying passengers from our ports.

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The work of the inspection service in detail is shown by the following tables:

VIOLATIONS OF NAVIGATION LAWS, SHOWING THE WORK DONE BY THE COAST GUARD, THE MOTOR VESSEL "TARRAGON," LOCAL INSPECTORS OF STEAM VESSELS, RADIO INSPECTORS, CUSTOMS OFFICERS, AND NAVIGATION INSPECTORS, FISCAL YEAR ENDED JUNE 30, 1915.[a]

[The work of the customs officers under allotments made by the Department are shown in the last column.]

Port.	Coast Guard.	Tarragon.	Local inspectors.	Radio inspectors.	Customs officers.	Navigation inspectors.	Total.	Cases reported under allotments.
Baltimore	30	107	6	.....	51	200	394	.....
Boston	46	80	30	12	268	.....	436	.....
Bridgeport	5	56	6	.....	49	.....	116	.....
Buffalo	19	.....	4	.....	6	12	41	.....
Charleston	40	5	15	.....	33	.....	93	.....
Chicago	167	.....	1	.....	10	.....	178	168
Cleveland	10	.....	10	1	83	.....	104	66
Denver	.....	.....	.....	.....	.....	.....	.....	.....
Des Moines	64	.....	.....	.....	22	.....	86	11
Detroit	125	.....	5	.....	134	28	292	41
Duluth	6	.....	5	.....	23	30	64	.....
Eagle Pass	.....	.....	.....	.....	.....	.....	.....	.....
El Paso	.....	.....	.....	.....	.....	.....	.....	.....
Galveston	.....	.....	17	.....	32	.....	49	.....
Great Falls	.....	.....	.....	.....	.....	.....	.....	.....
Honolulu	4	.....	.....	.....	8	.....	12	.....
Indianapolis	.....	.....	1	.....	1	3	5	.....
Juneau	7	.....	2	.....	36	.....	45	.....
Laredo	.....	.....	.....	.....	2	.....	2	.....
Los Angeles	1	.....	2	.....	179	.....	182	150
Louisville	.....	.....	1	.....	53	.....	54	33
Memphis	.....	.....	2	.....	42	10	54	.....
Milwaukee	6	.....	2	.....	.....	.....	8	.....
Mobile	6	.....	1	.....	100	.....	107	.....
New Orleans	67	.....	20	1	80	.....	168	.....
New York	54	271	117	4	147	23	616	45
Nogales	.....	.....	.....	.....	.....	.....	.....	.....
Norfolk	35	54	18	.....	119	108	334	.....
Ogdensburg	.....	.....	.....	.....	40	.....	40	36
Omaha	.....	.....	.....	.....	.....	.....	.....	.....
Pembina	.....	.....	.....	.....	.....	.....	.....	.....
Philadelphia	9	48	8	.....	216	585	866	.....
Pittsburgh	.....	.....	8	.....	5	.....	13	.....
Port Arthur	.....	.....	1	.....	32	.....	33	.....
Portland, Me	14	495	9	.....	52	.....	570	.....
Portland, Oreg	.....	.....	2	.....	272	.....	274	256
Providence	.....	.....	7	.....	14	.....	21	.....
Rochester	.....	.....	1	.....	27	.....	28	27
St. Albans	.....	.....	.....	.....	3	.....	3	.....
St. Louis	20	.....	2	.....	166	.....	188	147
St. Paul	.....	.....	.....	.....	1	.....	1	.....

[a] This statement is based on reports made by collectors of customs on Cat. 1078, and is approximately correct. At Chicago and San Francisco, however, allotments made by the Department were used by Coast Guard officers, and that service, as well as the allotment, has been credited with the results. The statement of cases reported under the Department allotments necessarily is approximate only.

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VIOLATIONS OF NAVIGATION LAWS, SHOWING THE WORK DONE BY THE COAST GUARD, THE MOTOR VESSEL "TARRAGON," LOCAL INSPECTORS OF STEAM VESSELS, RADIO INSPECTORS, CUSTOMS OFFICERS, AND NAVIGATION INSPECTORS, FISCAL YEAR ENDED JUNE 30, 1915—Continued.

Port.	Coast Guard	Tarragon.	Local inspectors.	Radio inspectors.	Customs officers.	Navigation inspectors.	Total.	Cases reported under allotments.
Salt Lake City	.....	.....	.....	.....	.....	.....	.....	.....
San Francisco	418	.....	.....	15	30	.....	463	418
San Juan	2	.....	.....	.....	21	.....	23	.....
Savannah	42	7	10	.....	20	.....	79	.....
Seattle	150	.....	5	.....	154	.....	309	3
Tampa	31	126	30	1	124	.....	312	.....
Wilmington, N. C.	2	176	13	.....	6	.....	197	.....
Total—								
1915 (48 ports)	1,380	1,425	361	34	2,661	999	6,860	1,401
1914 (49 ports)	922	1,762	734	27	3,275	.....	6,720	1,325

VIOLATIONS OF NAVIGATION LAWS REPORTED TO THE VARIOUS COLLECTORS OF CUSTOMS, SHOWING THE LAWS VIOLATED, FISCAL YEAR ENDED JUNE 30, 1915.

Port.	Steamboat laws (4399–4500, R. S.).	Motor-boat law, "Rules of road."	Surrendered license (4325–4326, R. S.).	Bills of health (Feb. 15, 1893).[a]	Anchorage and St. Marys River rules.	Passenger act (Aug. 2, 1882).	Enrollment and license (4336, R. S.).	Entry and clearance (4197–2774, R. S.).	Name on vessel (4178, R. S.).	Change of master (4335, R. S.).	Unlading and coasting laws.	Radio-communication laws.	Miscellaneous.	Total.
Baltimore	15	286	28	.....	.....	.....	1	.....	61	3	2	.....	....	376
Boston	31	310	70	.....	.....	.....	2	4	4	1	2	16	....	440
Bridgeport	5	87	18	.....	.....	.....	.....	1	4	.....	2	.....	1	118
Buffalo	2	34	.....	.....	4	.....	2	.....	.....	.....	.....	.....	....	42
Charleston	20	30	19	.....	.....	.....	1	.....	16	3	1	.....	1	91
Chicago	3	166	3	.....	1	.....	2	.....	1	2	.....	.....	....	178
Cleveland	16	71	10	.....	.....	.....	1	3	2	.....	.....	1	....	104
Denver	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	....	.....
Des Moines	.....	74	10	.....	.....	.....	1	.....	.....	.....	.....	.....	....	85
Detroit	8	244	30	.....	4	.....	.....	4	1	1	1	.....	....	293
Duluth	4	32	22	.....	2	.....	1	.....	.....	.....	1	.....	....	62
Eagle Pass	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	....	.....
El Paso	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	....	.....
Galveston	27	1	7	.....	.....	.....	.....	5	.....	.....	8	.....	1	49
Great Falls	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	....	.....
Honolulu	2	4	1	.....	.....	1	.....	.....	2	.....	4	.....	....	14
Indianapolis	.....	5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	....	5
Juneau	5	7	23	.....	.....	.....	1	.....	2	.....	4	.....	1	43
Laredo	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	....	2
Los Angeles	5	148	14	.....	.....	.....	.....	1	.....	1	8	.....	5	182
Louisville	2	36	20	.....	.....	.....	.....	.....	.....	.....	.....	.....	....	58
Memphis	2	8	39	.....	.....	.....	.....	.....	.....	.....	2	.....	1	52
Milwaukee	2	5	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	....	8
Mobile	4	16	58	.....	.....	.....	1	.....	26	2	.....	.....	....	107

[a] Bills of health cases transferred to Treasury Department July 24, 1911.

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VIOLATIONS OF NAVIGATION LAWS REPORTED TO THE VARIOUS COLLECTORS OF CUSTOMS, SHOWING THE LAWS VIOLATED, FISCAL YEAR ENDED JUNE 30, 1915—Continued.

Port.	Steamboat laws (4399-4500, R.S.).	Motor-boat law, "Rules of road."	Surrendered license (4325-4326, R.S.).	Bills of health (Feb. 15, 1893).	Anchorage and St. Marys River rules.	Passenger act (Aug. 2, 1882).	Enrollment and license (4336, R.S.).	Entry and clearance (4197, 2774, R.S.).	Name on vessel (4178, R.S.).	Change of master (4335, R.S.).	Unlading and coasting laws.	Radio-communication laws.	Miscellaneous.	Total.
New Orleans	27	89	51	.....	.....	.....	.....	.....	2	.....	2	2	....	173
New York	142	378	62	.....	.....	.....	10	.....	10	7	4	4	85	622
Nogales	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Norfolk	32	154	105	.....	.....	.....	6	.....	35	1	2	.....	.....	335
Ogdensburg	2	35	1	.....	.....	.....	.....	.....	.....	.....	2	.....	.....	40
Omaha	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Pembina	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Philadelphia	52	657	74	.....	.....	.....	43	.....	24	15	2	.....	.....	867
Pittsburgh	8	1	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	13
Port Arthur	25	.....	6	.....	.....	1	.....	.....	.....	.....	1	.....	.....	33
Portland, Me	22	483	50	.....	.....	.....	.....	10	.....	1	.....	.....	.....	566
Portland, Oreg	7	250	2	.....	.....	.....	4	.....	6	3	.....	.....	1	273
Providence	3	4	12	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	21
Rochester	1	27	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	28
St. Albans	.....	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3
St. Louis	2	145	31	.....	.....	.....	.....	.....	1	1	5	.....	1	186
St. Paul	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
Salt Lake City	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
San Francisco	76	181	26	.....	.....	4	19	6	63	14	30	12	15	446
San Juan	7	6	10	.....	.....	.....	1	1	1	2	.....	.....	.....	28
Savannah	16	40	4	.....	.....	.....	1	1	10	.....	5	.....	1	78
Seattle	12	142	104	.....	.....	4	4	5	29	2	2	1	1	306
Tampa, Fla	60	153	60	.....	.....	.....	1	.....	27	4	3	1	5	314
Wilmington, N. C	24	149	7	.....	.....	.....	2	.....	21	3	.....	.....	.....	206
Total—														
1915 (48 ports) [a]	671	4,462	982	.....	11	10	104	41	348	67	93	37	42	8,868
1914 (49 ports) [a]	768	4,838	631	.....	8	25	41	26	153	59	90	36	45	6,720
1913 (107 ports)	333	2,783	23	.....	23	8	24	10	83	26	1	40	152	3,506
1912 (105 ports)	165	3,119	96	3	12	17	38	39	81	12	.....	.....	52	3,634
1911 (92 ports)	182	1,811	23	41	17	45	10	16	43	30	.....	.....	50	2,268
1910 (74 ports)	252	488	17	52	13	61	13	16	68	12	2	.....	76	1,070
1909 (64 ports)	151	710	33	69	3	21	14	7	59	.....	4	.....	63	1,134
1908 (73 ports)	245	385	12	42	6	21	23	18	30	7	2	.....	61	852
1907 (66 ports)	209	92	88	36	18	62	9	23	52	27	5	.....	63	684
1906 (77 ports)	194	130	114	41	13	27	10	6	49	5	9	.....	72	670
1905 (63 ports)	142	53	99	42	13	21	26	7	20	11	28	.....	62	524
1904 (66 ports)	184	93	101	48	49	16	29	12	24	19	(b)	.....	131	706

[a] Reports are now made by subports through the principal port of the district.
[b] Included under "Miscellaneous" in 1904 report.

The estimate of the service for the enforcement of the navigation laws will call for an increase of $13,000 per annum over the present appropriation, making a total of $35,000. This is to permit the purchase of a motor vessel for enforcing the navigation

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laws on the Mississippi and Ohio Rivers and their tributaries and to allot local collectors of customs for the hire of motor boats for this purpose the sum of $2,270. As has been already stated, the operations of the motor vessels *Dixie* and *Tarragon* on the Atlantic coast are self-sustaining. They have resulted in widespread knowledge of the navigation laws which are now followed to an extent never before approximated. The waters of the Mississippi River and its tributaries are not patrolled and are practically the only waters thus neglected, for there are no Coast Guard vessels on them. Collectors of customs on these rivers estimate the following motor boats and small vessels:

Port.	Vessels.	Port.	Vessels.
New Orleans	4,000	Evansville	775
Memphis	450	Louisville	700
St. Louis	5,000	Cincinnati	492
Chicago	1,400	Dayton	150
Peoria	1,500	Pittsburgh	1,000
Rock Island	265	Wheeling	250
Milwaukee	2,500		
Des Moines	3,000	Total	22,482
St. Paul	1,000		

In addition to the above, the vessel during the winter season would make inspections at Gulf ports in Texas, Louisiana, Mississippi, Alabama, and the west coast of Florida.

Collectors of customs advise that the trifling allotments made them heretofore have developed almost total ignorance of the laws providing for safety equipment on the part of owners outside of the principal river ports. The nature of the waters is such that currents, shallows, and floating obstructions offer a menace to small vessels rarely if anywhere found to an equal extent. Hence the need for knowledge of and compliance with the laws is unusually great.

Collectors of customs at all these river ports urge the need for systematic inspection. The Mississippi Valley Power Boat Association, comprised of 60 clubs, with a membership of about 15,000, is in accord with the service. The proposed motor vessel would be available to patrol courses when regattas are held. She would be equipped with wireless and be of service in time of flood. She would provide a supervision not now possible for excursion steamers carrying hundreds of thousands of passengers.

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It is important to note in addition that this work is correcting the evils against which it is directed. In the Potomac River; in the sounds of North Carolina; in many other places the owners of small vessels show a commendable desire to comply with the laws when once they are informed concerning them and are satisfied that they are being equally enforced.

Since the passage of the act of June 9, 1910, there has developed a tendency on the part of certain motor-boat owners found in violation of the navigation laws to give fictitious names to the inspecting officer, resulting in their escaping any punishment for their infraction of the law. The practice is steadily growing, until of 670 cases discovered in the New York collection district at least 25 per cent of the owners could not be found.

It also developed that at least 50 per cent of the time of making inspections was consumed and a great deal of annoyance caused to motor-boat owners by the difficulty met by the inspection officers in securing the names and addresses of such owners.

Under existing law also there is no restriction on the number of passengers which a motor boat may carry, and in several localities our officers found vessels loaded with passengers far beyond the limits of safety, but were unable to prevent this dangerous navigation if the vessel was fully equipped with life-saving devices. Passengers are being carried for hire by operators who know little or nothing of the rules of the road and but little more about the operation of their engines and the steps to be taken in case of accident or in an emergency.

The Department is satisfied if motor vessels carry the equipment now required by statute and are carefully navigated that a reasonable degree of safety will be secured except in the case of vessels carrying large numbers of passengers.

This matter was brought to the attention of representative motor-boat owners, builders, and yachting organizations and associations. On June 10 a conference on this subject was held in this Department and after full consideration a proposition requiring the numbering of all undocumented vessels propelled by machinery, excepting those of 16 feet or under temporarily equipped with detachable motors, was approved and also a proposition that all motor boats not now covered by statute, carrying 20 or more passengers for hire, should be inspected, be limited as to the number of passengers they should carry, and the operator be examined as to his general knowledge of the machinery and of the waters on which the vessel is to navigate.

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I am satisfied that in the interests of the enforcement of the existing law and the proper protection of the passengers on crowded motor boats this additional legislation should receive the favorable consideration of Congress.

Navigation Inspectors.

On July 29, 1914, the Congress provided $15,000 for the hire of navigation inspectors to be employed in connection with custom officers in preventing the overcrowding of vessels. There were not available a sufficient number of persons eligible for appointment to this position and a special civil-service register was created after a careful examination as to the intelligence and qualifications of the applicants. This examination was such as to enable us to secure a number of young men working their way through college who could accept this summer employment. After two years' service these men are eligible for transfer to any other branch of the service, and this additional inducement enabled the Department to secure an especially high grade of men for this work. It will be a nucleus which can be drawn upon in the future in establishing field forces in the Navigation Service.

The results during the latter part of the summer of 1914 and the spring of 1915 have amply justified the Department's expectations. During this period these inspectors counted 1,439,273 passengers on 5,061 trips. On 92 occasions the inspectors stopped passengers from going on board, as the limit permitted the vessel had been reached. The safety of 95,293 passengers was involved in these cases. It is fair to presume that on at least a portion of these occasions an excess of passengers would have been carried had our inspectors not been present.

In addition to the work of counting passengers these inspectors, while not so employed, discovered 999 violations of the navigation laws, most of these being the failure of motor boats to have proper equipment.

The work of the inspectors is not confined to counting passengers, but they are alert to see that all vessels carrying such passengers are properly equipped, manned, and as far as possible navigated in accordance with the law. When this service is fully organized, between 60 and 70 inspectors, carefully trained in their work and fully imbued with the seriousness of the work in which they are engaged, will be employed.

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Passenger Act of 1882.

During the year ended June 30, 1914, passenger steamers subject to the passenger act of 1882 carried 1,016,453 steerage passengers on 1,797 voyages to ports of the United States where they were subject to detailed inspection. As a consequence of the European war, during the year ended June 30, 1915, such steamers carried only 211,509 steerage passengers on only 956 voyages. Of this greatly reduced number the month of July before the outbreak of the war, and the month of August, when many Americans came home in the steerage, furnished 322 of the voyages and 110,021 of the steerage passengers. The law has been carefully enforced during the year as to outgoing and incoming steamers.

Load-Line Regulation.

The number of our ocean cargo steamers has increased so rapidly that the matter of load-line regulation ought not to be postponed beyond the present session of Congress. This subject is one of some intricacy, and if our cargo ships are to compete in foreign trade with similar ships of other nations our rules ought to be reasonably similar to those adopted by other countries. The most satisfactory method of meeting this question, of course, would be by international agreement, and twice this Department has asked Congress for an appropriation for American representation at a proposed international load-line conference. Such a conference, of course, can not now be expected to meet for several years, until the war has closed and nations have resumed normal trade relations. We can not postpone the subject so long. The subject matter, of course, is within the jurisdiction of this Department. It seems to me that the practical method of meeting the situation would be to empower the Department to employ, say, three experts to frame the necessary regulations. These regulations, if approved by the Secretary of Commerce, should have the force of law, or, if Congress should prefer, such regulations might be submitted for its approval later in the session. The matter is of so much importance both to the safety of shipping and to commercial competition that men of the highest standing should be selected to draft the regulations. These men, of course, should be adequately paid for their work, and provision should be made for the necessary clerical assistance and other expenses. A bill to carry out the above recommendations and to provide the necessary force and funds will be introduced at the coming session of Congress.

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Service Rendered by British Steamship "Megantic."

In a year marked by so many attacks upon life at sea, it is some relief to find humanity reasserting itself in saving men and women from the natural perils of the ocean. To place on public record an unselfish service to Americans, a letter which on April 7, 1915, I sent to Capt. George R. Metcalfe, of the British steamship *Megantic*, is here repeated:

DEPARTMENT OF COMMERCE,
OFFICE OF THE SECRETARY,
Washington, April 7, 1915.

DEAR SIR: Your report to the managers of the White Star Line of your part in the rescue of the captain, crew, and passengers of the American steamship *Denver* has been laid before me.

On March 22 at 3.30 p. m. the steamship *Denver* sent out the wireless call, "We are sinking and in urgent need of assistance." Although your ship was then 206 miles distant from the position of the *Denver* shown in her distress call, you changed your course and in a whole gale, with a high and dangerous sea running, you went to her rescue. On the 23d at 4.10 p. m. you sighted the *Denver* and sent a boat in charge of First Officer Fred J. Bard to her rescue, taking off the master of the *Denver* and his wife, 13 of the crew, and Capt. Smith of the American steamship *Evelyn*, which had been sunk by mines on the German coast.

I have asked the Secretary of State to recognize in a suitable manner the services of yourself and of the crew of the British steamship *Megantic* in rescuing American seamen and citizens from shipwreck. In due course you will doubtless receive from him the material acknowledgment for which the laws of the United States provide. In the meantime, however, I wish to assure you of my own appreciation of the high courage of yourself and those under your command and of your unselfish services to the officers, crew, and passengers of an American merchant vessel in distress.

Respectfully,

WILLIAM C. REDFIELD, *Secretary.*

Capt. GEORGE R. METCALFE,
Steamship "Megantic," International Mercantile Marine Co.,
9 Broadway, New York, N. Y.

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CONCLUSION.

I spoke plainly in this portion of my last report of what is called economy, and what was then said I now reaffirm. To judge of economy by the totals of appropriations in any one year is a mere waste of words, meaning nothing. Wise expenditure is true economy—to spend nothing where expenditure is unnecessary; to spend little where little is required; to spend liberally where the circumstances call for it; and to have always in mind the productiveness to arise from the expenditure. To anyone familiar with accounting or with business or industrial management, to say that a man or a congress or a nation is extravagant merely because it spends largely is to put the critic in a laughable position. Was the expenditure needed? Was the money well and productively spent? Was what was spent a due proportion of the funds available for all purposes? These and others like them are the questions that determine economy, but it is the merest trifling to take an aggregate and assume either economy or the reverse from it.

Illustrations are not wanting in the foregoing report of the costliness of what is sometimes called economy. Was it economical to have the *Albatross* lie at the dock month after month with her crew under full pay for lack of an appropriation sufficient to buy supplies and coal? Was it economical to keep in service such wrecks as the *McArthur* and the *Gedney*, only to replace them when prices are high and when vessels must be hired while the new ones are building lest the work needed for saving human life should stop? Is there economy in stopping the reinspections of the Steamboat-Inspection Service in the busiest month of the year and in giving instructions to supervising inspectors to go about their districts as little as possible because there is not money enough for traveling expenses?

These and other things like them are the results neither of economy nor of accurate knowledge of the work required. They mean only loss to the country, and the people of the country do not, in my judgment, want this sort of thing to go on.

So also anyone familiar with real economy must smile at the humorous picture presented by a commercial agent collecting

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knowledge around the world and then being forbidden, save at his personal cost, to communicate that knowledge to a meeting of the men for whom he gathered it. The feeling is rather one of pity than of humor when a subordinate employee, obliged to travel in an expensive portion of the country, must pay a portion of his traveling expenses out of his own limited pocket because the law so requires. Whatever the cause that led to the latter restrictions, the remedies sought by them are worse than the diseases that they aim to cure, and the injustice wrought by them will continue to call for remedy until an equitable treatment of them is secured. No one intended that these absurdities of the law should exist any more than they intended that great Government departments should have to discuss the color of bears.

There is no criticism of person or persons in the discussion of these matters. The effective administration of the public service, however, requires that they be made clear and the bringing of the facts to light is certain to lead to their correction.

Respectfully,

WILLIAM C. REDFIELD,
Secretary.

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REPORTS

OF THE

DEPARTMENT OF COMMERCE

BUREAU OF FOREIGN AND DOMESTIC COMMERCE
BUREAU OF STANDARDS
BUREAU OF THE CENSUS
BUREAU OF FISHERIES
BUREAU OF LIGHTHOUSES
COAST AND GEODETIC SURVEY
STEAMBOAT-INSPECTION SERVICE
BUREAU OF NAVIGATION
APPOINTMENT DIVISION
DIVISION OF PUBLICATIONS

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REPORT

OF THE

CHIEF OF BUREAU OF FOREIGN AND DOMESTIC COMMERCE

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REPORT

OF THE

CHIEF, BUREAU OF FOREIGN AND DOMESTIC COMMERCE.

DEPARTMENT OF COMMERCE,
BUREAU OF FOREIGN AND DOMESTIC COMMERCE,
Washington, July 1, 1915.

SIR: In beginning this, my first annual report as Chief of the Bureau of Foreign and Domestic Commerce, it is my duty and pleasure to call your attention to the excellent work of my predecessor, who resigned on October 5 to become commercial attaché at London. Under his direction the work of this Bureau reached a high degree of efficiency and its further development will be based on the very firm and solid foundation which he laid.

I.

GENERAL EXPORT SITUATION.

This great European war has suddenly and in a moment thrust before the eyes and imagination of the American business community the subject of foreign trade. As a matter of fact, the American business community is rapidly being forced into the world's trade arena. The United States has been compelled to become the world's producing and commercial center and, for a time at least, the world's financial center.

OPPORTUNITY FACING AMERICAN MANUFACTURERS.

The world situation as it exists to-day is for this country one of opportunity and one of obligation. Our opportunity lies in the fact that the business community is aware of the existence of foreign markets, sees the many advantages of securing them, and is now positively desirous of doing an export business. The European war has advertised foreign trade to the American business man. The mere fact that our chief competitors are at present otherwise engaged is of merely temporary interest. The obligation which rests upon our business community is to fill for the time being the rôles in the world's markets voluntarily laid aside by the other great nations of the world. We must supply to the newer countries raw materials, manufactured goods, finances, and, most important of all, enterprise. Of no less importance, we must supply a market for the products of our new customers. The obligation of our present situation is as

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great as the opportunity, for we have in our power the well-being of many other nations.

The United States has a very vital interest in foreign trade. The events following the first of August of last year have driven this fact home with compelling force. In the two weeks immediately following the declaration of war in Europe our over-sea commerce came practically to a standstill, the rates of sterling exchange on London went to unprecedented heights, the stock exchange was forced to close, as were many other business exchanges, commercial failures multiplied, and a for a few days business stood paralyzed awaiting the outcome of the first shock. These things occurred to us, thousands of miles across the seas from the field of active hostilities. They happened to us, a nation which has prided itself on its economic independence. They have demonstrated our economic dependence, or rather the closeness of our economic relationship with Europe and our vital interest in foreign trade and international commerce.

The business public does not, I believe, fully appreciate the severity of the crisis through which the United States passed during the weeks and months immediately following the first of August, 1914. It is not too much to say that the United States experienced the severest financial strain in her history during those weeks. The volume of emergency currency issued under the Aldrich-Vreeland Act and by various clearing-house associations amounted to $596,260,025. When compared with the amounts issued during other crises—$255,536,300 in 1907, and $69,111,000 in 1893—and even taking into consideration the ease of emission of the Aldrich-Vreeland emergency currency, these facts indicate the severity of the situation. Our crisis, however, in its immediately disastrous results and in far-reaching economic effects, is scarcely to be compared in importance and severity with the situation which was forced upon the various countries of Latin-America. To a degree, the same conditions existed in many other neutral countries. For a few days it was impossible, and for several weeks it was extremely difficult, to make international payments. Imports and exports practically ceased and the commerce and industry of the whole world awaited the outcome of this critical situation.

The accompanying table (No. 1), showing the imports and exports of the United States, month by month, during the fiscal years of 1914 and 1915, gives some indication of the situation and also indicates the extent of the recovery up to the end of the past fiscal year.

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TABLE 1.—IMPORTS AND EXPORTS OF MERCHANDISE INTO AND FROM THE UNITED STATES, JULY, 1913, TO JUNE, 1915, BY MONTHS.

Month.	Imports.				Exports.			Excess of—	
	Free of duty.	Dutiable.	Total.	Per cent of free.	Domestic.	Foreign.	Total.	Imports.	Exports.
1913.									
July	$71,806,155	$67,255,615	$139,061,770	51.6	$158,173,653	$2,817,125	$160,990,778	.....	$21,929,008
August	70,062,817	67,588,736	137,651,553	50.8	185,114,278	2,794,747	187,909,020	.....	50,257,467
September	92,031,627	79,053,216	171,084,843	53.8	215,817,627	2,422,374	218,240,001	.....	47,155,158
October	81,553,889	51,395,413	132,949,302	61.4	269,003,434	2,858,030	271,861,464	.....	138,912,162
November	91,498,137	56,738,399	148,236,536	61.7	243,375,068	2,163,974	245,539,042	.....	97,302,506
December	117,547,218	66,478,353	184,025,571	63.9	230,483,344	2,712,284	233,195,628	.....	49,170,057
1914.									
January	94,511,619	60,231,304	154,742,923	61.1	201,609,006	2,457,597	204,066,603	.....	49,323,680
February	92,471,968	55,572,808	148,044,776	62.5	171,605,138	2,315,007	173,920,145	.....	25,875,369
March	111,644,978	70,910,326	182,555,304	61.2	183,934,601	3,564,633	187,499,234	.....	4,943,930
April	107,779,852	65,982,262	173,762,114	62.0	158,969,703	3,582,867	162,552,570	$11,209,544	.....
May	103,148,377	61,133,138	164,281,515	62.8	157,492,718	4,239,901	161,732,619	2,548,896	.....
June	93,446,062	64,083,388	157,529,450	59.4	154,105,460	2,966,584	157,072,044	457,406	.....
Total, 12 months	1,127,502,699	766,422,958	1,893,925,657	59.5	2,329,684,025	34,895,123	2,364,579,148	.....	470,653,491
July	94,585,449	65,091,842	159,677,291	59.2	150,959,659	3,179,288	154,138,947	5,538,344	.....
August	80,268,143	49,499,747	129,767,890	61.9	108,198,262	2,169,232	110,367,494	19,400,396	.....
September	85,179,372	54,531,239	139,710,611	60.9	153,201,392	2,850,941	156,052,333	.....	16,341,722
October	86,944,520	51,136,000	138,080,520	63.0	190,329,376	4,381,794	194,711,170	.....	56,630,650
November	78,512,793	47,954,269	126,467,062	62.1	200,008,223	5,870,110	205,878,333	.....	79,411,271
December	69,444,579	45,211,966	114,656,545	60.6	240,644,206	4,988,352	245,632,558	.....	130,976,013
1915.									
January	76,387,094	45,761,223	122,148,317	62.6	263,636,192	4,243,121	267,879,313	.....	145,730,996
February	79,963,995	45,139,396	125,123,391	63.9	294,322,195	5,483,674	299,805,869	.....	174,682,478
March	95,466,379	62,515,637	157,982,016	60.4	292,360,231	4,251,621	296,611,852	.....	138,629,836
April	102,120,583	58,455,513	160,576,106	63.6	289,037,456	5,708,457	294,745,913	.....	134,169,807
May	85,400,692	56,884,159	142,284,851	60.0	269,336,222	4,881,920	274,218,142	.....	131,933,291
June	99,233,066	58,462,074	157,695,140	62.9	264,145,051	4,402,365	268,547,416	.....	110,852,276
Total, 12 months	1,033,526,675	640,043,065	1,674,169,740	61.7	2,716,178,465	52,410,875	2,768,589,340	.....	1,094,419,600

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That our recovery has been considerable is evidenced by the complete change in the exchange situation. The rate of sterling exchange stood at the remarkably high level of 5.50 on July 31, 1914. It then declined almost steadily until the present time. On December 25, 1914, it had declined to 4.85⅛ and on July 2, 1915, it had declined to 4.75¾.[a] Of course, this merely indicates that at the beginning of the war American obligations to be met in London far exceeded foreign obligations to be met in New York, and by the close of the year the situation had entirely reversed and the foreign obligations to be met in New York considerably exceeded American obligations to be met in London. As the fiscal year ends we find the statesmen of England conferring with their bankers and with our bankers, seeking a way in which to keep sterling exchange more nearly at par.

It is of great importance, not only to Great Britain and the other European countries but to the United States as well, that the exchange rates be kept near par. Next in importance to having a good customer is the ability of that good customer to meet his payments. The present rate of exchange constitutes a severe tax on some of our best customers. If sterling exchange on London stands at 4.76, it constitutes a tax of about 2 per cent on every European purchase in the United States. That is, the English purchaser has to pay £1, worth at par $4.8665, for every $4.76 worth of merchandise he buys in this country—or 2 per cent above the price of goods quoted in dollars. This is a tax from which we derive no benefit whatever. These facts should make us anxious to restore exchange to par and thus facilitate the movement of American commerce.

It is also worth while to note the character of our exports. The accompanying tables (Nos. 2 and 3), show the main classes of exports from this country. Our gains during the past year are more marked in foodstuffs than in any other group, although manufactured products increased rapidly and steadily toward the close of the year.

TABLE 2.—VALUE AND PERCENTAGE OF GREAT GROUPS OF EXPORTS OF DOMESTIC MERCHANDISE FROM THE UNITED STATES DURING THE FISCAL YEARS ENDED JUNE 30, 1914 AND 1915.

Great groups.	1914		1915	
	Value.	Per cent.	Value.	Per cent.
Crude materials for use in manufacturing	$792,716,109	34.03	$509,436,254	18.76
Foodstuffs in crude condition, and food animals	137,495,121	5.90	507,064,610	18.67
Foodstuffs partly or wholly manufactured	293,218,336	12.59	452,767,729	16.67
Manufactures for further use in manufacturing	374,224,210	16.06	357,459,326	13.15
Manufactures ready for consumption	724,908,000	31.11	808,634,402	29.77
Miscellaneous	7,122,249	.31	80,816,144	2.96
Total domestic exports	2,329,684,025	100.00	2,716,178,465	100.00

[a] Finally, toward the end of August the market broke sharply and a low record of $4.50 was established on Sept. 1, 1915.

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TABLE 3.—VALUE OF GREAT GROUPS OF EXPORTS OF DOMESTIC MERCHANDISE FROM THE UNITED STATES, JULY, 1913, TO JUNE, 1915, BY MONTHS.[a]

Month.	Crude materials for use in manufacturing.	Foodstuffs in crude condition, and food animals.	Foodstuffs partly or wholly manufactured.	Manufactures for further use in manufacturing.	Manufactures ready for consumption.	Miscellaneous.	Total.
1913.							
July	$27,146,725	$12,944,652	$23,138,221	$33,730,895	$60,811,467	$401,693	$158,173,653
August	35,333,193	26,731,226	23,957,583	34,026,345	64,710,943	354,983	185,114,273
September	83,623,944	14,842,403	23,944,221	31,386,893	61,550,063	470,083	215,817,627
October	125,239,556	11,764,519	29,775,473	32,678,284	68,824,465	721,137	269,003,434
November	118,225,262	8,879,251	29,908,437	28,146,671	57,654,126	561,321	243,375,068
December	97,305,782	9,977,309	27,801,285	29,799,156	64,899,845	699,967	230,483,344
1914.							
January	80,781,807	9,085,370	29,179,696	29,537,534	52,415,369	609,230	201,609,006
February	60,185,126	8,549,477	22,153,990	28,491,259	51,685,466	539,820	171,605,138
March	56,319,364	7,168,732	22,989,066	32,856,618	63,739,633	861,188	183,934,601
April	37,627,006	6,328,730	19,590,417	31,844,607	62,557,755	1,021,188	158,969,703
May	37,816,066	10,078,917	20,117,749	30,431,865	58,563,302	484,799	157,492,718
June	32,872,355	11,047,074	20,075,216	31,755,039	58,070,674	285,102	154,105,460
July	22,656,281	27,937,100	17,988,203	29,584,204	52,519,267	274,604	150,959,659
August	12,237,695	28,610,358	18,596,504	16,208,545	32,357,363	187,797	108,198,262
September	18,235,571	41,735,104	26,890,785	21,197,243	44,042,877	1,099,812	153,201,392
October	32,289,050	36,224,327	37,411,532	28,571,130	53,589,172	2,244,165	190,329,376
November	42,346,511	36,890,642	36,158,374	25,669,658	53,238,328	5,704,710	200,008,223
December	57,111,046	51,620,069	37,706,166	28,853,223	56,136,776	9,216,926	240,644,206
1915.							
January	68,622,400	49,798,768	41,143,468	30,130,946	64,038,743	9,901,867	263,636,192
February	75,585,753	57,996,682	47,780,948	28,449,006	73,476,997	11,032,809	294,322,195
March	61,179,943	52,129,999	55,249,913	33,228,673	80,808,513	9,763,190	292,360,231
April	44,355,870	59,414,365	46,618,860	38,451,343	90,503,475	9,693,543	289,037,456
May	44,337,493	38,752,970	40,828,391	36,872,883	97,546,042	10,998,443	269,336,222
June	30,478,641	25,954,226	46,394,585	40,242,472	110,376,849	10,698,278	264,145,051

[a] The monthly statistics in this table are based on unrevised returns, as published in the Monthly Summary of Foreign Commerce, and show minor variations from the revised annual statistics in Table 2.

The American business community should guard against any sense of safety in our present prosperity in so far as that prosperity is based on business connected with the belligerent activities in Europe. Our business men should carefully discount the continuance of so-called war orders and avoid basing future calculations upon conditions which they bring into existence.

European war orders doubtless are bringing to some manufacturers immediate and large profits. They do not in any way, however, indicate permanent business. It is conceivable that they may be positively injurious, by diverting the attention of our manufacturers from foreign markets in Latin America, the Far East, Africa, and Australia, to which we should at the moment be directing our most earnest efforts. We may be voluntarily giving up our greatest opportunities. We may be foregoing the permanent markets of the world to make a few extra dollars of immediate profits.

Our exporters are also becoming confirmed in the very bad habit of demanding cash—a habit which if formed now, when to demand cash is easy and natural, may seriously handicap us in developing foreign markets after the present abnormal conditions have passed away.

We must not forget, in the midst of our rapidly increasing balance of trade and steadily enlarging volume of exports, that our best

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customers are exhausting themselves in a struggle which is bound to bring gain to no one—only loss and exhaustion to all. By far the largest part of our export trade has hitherto been with Europe. In the fiscal year 1914 nearly 63 per cent and last year over 71 per cent of our exports went to Europe. Our trade with the principal countries and the grand divisions of the world is given in Table 4.

TABLE 4.—EXPORTS OF DOMESTIC AND FOREIGN MERCHANDISE FROM THE UNITED STATES, BY PRINCIPAL COUNTRIES AND BY GRAND DIVISIONS, DURING THE FISCAL YEARS ENDED JUNE 30, 1914 AND 1915.

Country.	1914		1915	
	Value.	Per cent of total.	Value.	Per cent of total.
Europe:				
Belgium	$61,219,894	2.59	$20,662,315	0.75
Denmark	15,670,135	.66	79,824,478	2.88
France	159,818,924	6.76	369,397,170	13.34
Germany	344,794,276	14.58	28,863,354	1.04
Italy	74,235,012	3.14	184,819,683	6.68
Netherlands	112,215,673	4.75	143,267,019	5.17
Norway	9,066,610	.38	39,074,701	1.41
Russia	30,088,643	1.27	37,474,380	1.36
Spain	30,387,569	1.29	38,112,969	1.38
Sweden	14,644,226	.61	78,273,818	2.83
United Kingdom	594,271,863	25.13	911,792,454	32.93
Other Europe	40,085,904	1.70	39,869,841	1.44
North America:				
Canada	344,716,981	14.58	300,692,405	10.86
Central America	39,439,117	1.67	33,585,728	1.21
Mexico	38,748,793	1.64	34,164,447	1.23
Cuba	68,884,428	2.91	75,530,382	2.73
Other North America	36,855,643	1.56	33,108,358	1.20
South America:				
Argentina	45,179,089	1.91	32,549,606	1.18
Brazil	29,963,914	1.27	25,629,555	.93
Chile	17,432,392	.74	11,377,181	.41
Other South America	31,964,514	1.35	29,767,615	1.07
Asia:				
China	24,698,734	1.04	16,402,475	.59
East Indies	19,463,324	.82	18,771,424	.68
Japan	51,205,520	2.17	41,514,792	1.50
Other Asia	18,058,038	.77	37,778,814	1.36
Oceania:				
Australia and New Zealand	54,725,340	2.31	51,986,649	1.88
Philippine Islands	27,304,587	1.15	24,755,320	.89
Other Oceania	1,538,490	.07	1,022,756	.04
Africa:				
British Africa	18,960,770	.80	18,271,085	.66
Other Africa	8,940,745	.38	10,248,566	.37
Total	2,364,579,148	100.00	2,768,589,340	100.00
Europe	1,486,498,729	62.86	1,971,432,182	71.21
North America	528,644,962	22.36	477,081,320	17.23
South America	124,539,909	5.27	99,323,957	3.59
Asia	113,425,616	4.80	114,467,505	4.13
Oceania	83,568,417	3.53	77,764,725	2.81
Africa	27,901,515	1.18	28,519,651	1.03

It is possible that, when the war and the immediate readjustment to follow are concluded, a large part of our present exports will cease to flow to Europe. It is probable that Europe will be unprepared to resume her purchases from the United States on a scale as large as before the war. Moreover, the sales that are made will probably be largely on credit for a considerable time. It would seem, therefore, to be the part of prudence for us to distribute our trade so widely over the world's markets that the cessation of our business with Europe will be proportionately less important. This under-

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taking, however, is by no means a small one; but we must assume it, and that successfully, if we are not to experience a diminution of our foreign trade immediately following the close of the war.

A tremendous opportunity lies before the business community of the United States. Unquestionably, this is the time for the American manufacturer to develop foreign markets; not so much, perhaps, with the idea of getting immediate cash orders but with the idea of laying the foundation and establishing commercial relations for future business. I am glad to report that many American business concerns are taking this attitude. Many houses are sending out not mere salesmen but business diplomats, who will not devote themselves solely to taking orders but who will build up business connections and thus lay the foundation for future trade.

PROBLEMS DEMANDING SOLUTION.

It is particularly appropriate that I should call your attention at this time to certain problems which are facing this country in the development of foreign trade. These problems demand attention and solution, if we are to become a truly great commercial nation and if we are to accept the responsibilities and opportunities which now confront us.

There are before us two problems of commanding importance. The first is the problem of financing our foreign trade and the second is the problem of educating men to carry on our foreign trade.

FINANCING FOREIGN TRADE.

The financing of our foreign trade, and in fact by far the larger part of the financing of the world's trade, has hitherto been done through London. During the last hundred years London has been the world's financial market. She has held her position not because of prestige merely, but because the nations of the world needed an international clearing house and London supplied that. At the same time London became the clearing house chiefly because she supplied a large part of the capital needed for public improvements and large private enterprises.

On the other hand, the United States has never taken any large part in financing foreign trade because of the comparatively small volume of that business carried on here and also on account of the unfamiliarity of many of our bankers with the methods of international finance. Nor has the United States taken any large part in supplying capital to other countries. On account of more profitable investments at home we have chosen to invest here rather than abroad. This has also been true because of our position as a debtor nation, but probably also to a considerable degree because of a "mental debtor-nation attitude" on the part of our financiers.

On account of the war this situation is rapidly changing. The volume of foreign business done through New York is continuously increasing and New York banks are rapidly providing facilities for Americans who wish to export. "Dollar exchange," a thing practically unheard of prior to this year, is assuming constantly enlarging importance in the financial world and is rapidly becoming popular as a means of meeting international obligations.

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The most important development in the financial situation, however, is the large net favorable balance of trade which is accumulating month by month. The change in our status from a debtor to a creditor nation on current account and to an extent on capital account, and the large loans which we are now making to other nations, are facts which deserve more than passing notice.

The term "balance of trade" is one which is often misinterpreted. As popularly used, the term "balance of trade" merely means the excess of exports over imports. As a matter of fact, however, the real balance of trade is something very different from this. The excess of exports over imports is only an apparent balance which has for several years been favorable to the United States. This apparent balance is shown in Table 5.

TABLE 5.—IMPORTS INTO AND EXPORTS FROM THE UNITED STATES DURING THE FISCAL YEARS ENDED JUNE 30, 1900 TO 1915.

Year.	Imports.	Exports.	Excess of exports.
1900	$849,941,184	$1,394,483,082	$544,541,898
1901	823,172,165	1,487,764,991	664,592,826
1902	903,320,948	1,381,719,401	478,398,453
1903	1,025,719,237	1,420,141,679	394,422,442
1904	991,087,371	1,460,827,271	469,739,900
1905	1,117,513,071	1,518,561,666	401,048,595
1906	1,226,562,446	1,743,864,500	517,302,054
1907	1,434,421,425	1,880,851,078	446,429,653
1908	1,194,341,792	1,860,773,346	666,431,554
1909	1,311,920,224	1,663,011,104	351,090,880
1910	1,556,947,430	1,744,984,720	188,037,290
1911	1,527,226,105	2,049,320,199	522,094,094
1912	1,653,264,934	2,204,322,409	551,057,475
1913	1,813,008,234	2,465,884,149	652,875,915
1914	1,893,925,657	2,364,579,148	470,653,491
1915	1,674,169,740	2,768,589,340	1,094,419,600

There are, however, certain invisible factors entering into the balance of trade which must be taken into account before we can determine whether or not we have a real balance of trade for or against us. The most important of these invisible factors are the payments of interest which we must make to Europe on capital loaned us, the expenditures of American tourists in Europe, the amounts remitted by foreigners resident in this country to friends abroad, and the payments to foreign-owned steamships for carrying our imports. These sums have been variously estimated. The general consensus of expert opinion seems to indicate, however, that, speaking in round numbers, the sums which we must remit annually on these various accounts may be estimated about as follows:

Interest payments	$300,000,000
Expenditures of American tourists	250,000,000
Remittances to friends abroad	150,000,000
Payments to foreign shipping	50,000,000
Total	750,000,000

This indicates, therefore, that even in the year when we enjoyed the highest excess of exports over imports we still had a net unfavorable balance and had to remit a considerable sum to Europe over and above the excess of our exports. Usually the amount of this unfavorable balance has not been met by remitting gold, but Europe has

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elected to take this surplus in the shape of American securities and has thus loaned the United States a tremendous volume of capital which has been variously estimated at from $3,000,000,000 to $7,500,000,000. The United States has, therefore, been constantly increasing her indebtedness to Europe; hence the expression that the United States is a debtor nation.

The situation has completely changed within the last six months. This is true, first of all, because of the increasing excess of exports over imports, due not only to an increase in the amount of exports but due also to the decrease in the amount of imports. Secondly, the expenditures of American tourists have been greatly reduced. Thirdly, the amount of money sent abroad by foreigners resident in this country has considerably decreased—at least one-half—probably on account of the uncertainty of conditions in this country and abroad, and also as regards the uncertainty of delivery. In view of these decreases, it is not likely that we are obligating ourselves to Europe by more than $40,000,000 a month, or a total of about $500,000,000 a year. This means, therefore, that on the basis of the actual figures of imports and exports for the last six months of the fiscal year 1915 and on the basis of the estimated sums due Europe, that we have accumulated during this period a net favorable balance of about $600,000,000. This sum of money is, therefore, available at the present moment for the purchase of our securities which have been held in Europe, or for the purpose of making direct loans to other countries, or for the purchase of securities in other countries. These facts indicate, therefore, clearly and beyond the possibilty of dispute, that at least on current account the United States has changed her international position of a debtor country into one of a creditor country. It is also evident that if this process goes on with equal rapidity for the next five or six years, the United States will be able to completely discharge her obligations to Europe or will be able to loan very considerable sums to other countries for governmental or private purposes.

The proof that this is not merely a theoretical statement of the case is to be found in the fact that we have already made considerable loans to other countries. During the fiscal year 1914–15 we have made formal loans to foreign countries to the total amount of $256,690,000. In addition to these formal loans, an unknown but probably considerable amount of credit has been established in this country on account of foreign nations. It is not unlikely that such credits total well over $250,000,000. If these figures are even approximately correct, they indicate that the United States is playing a highly important part in world finance and that New York is to some degree taking the place of London among the international money markets.

There was floated in the London market approximately $448,000,000 worth of foreign securities during the year ending June 30, 1914. The total volume of securities floated in the New York market during the fiscal year of 1915 compares very favorably with the volume floated in London. The comparison is especially favorable when we consider the severe financial crisis, which has been referred to above, that took place during the months of August, September, October, and November.

Two provisions in the Federal reserve act of 1913 have been of very material assistance to our foreign trade. These provisions are

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(1) the introduction of the use of acceptances into our banking practice and (2) the permission granted to national banks to establish branch banks in foreign countries. These two provisions have placed much needed tools in the hands of our banks and have removed some of the handicaps under which we had labored heretofore in developing foreign trade.

The provision of the Federal reserve act which permits national banks to accept six months' bills drawn against actual shipments of merchandise in foreign commerce, and which provides that these bills when within 90 days of maturity may be rediscounted by the Federal reserve banks, has done much to promote foreign trade. Already a considerable discount market has been established in New York. The English acceptance houses have played an important part in making London the financial center of the world. London always furnished a ready market for discounting bills from all parts of the world. This method of doing business was until recently practically unknown in the United States.

The importance of this new source of credit which has been placed at the disposal of American manufacturers, exporters, and importers by the acceptance privilege may be appreciated when it is considered that the combined capital and surplus of all the national banks in June, 1915, was $1,790,000,000. The amount of accepted bills of exchange arising out of foreign trade transactions which the new law permits to be outstanding may equal these amounts. The acceptance privilege will result in the building up in New York of a ready discount market in foreign bills and there will surely follow a heavy demand for acceptances. In this way a large part of the money with which to finance our foreign trade and to grant the credits that are necessary will be furnished through the banks from the savings of investors of the country. Credits based on financial considerations other than direct foreign trade acceptances also may figure in financing export sales; for such credits American banking resources are large, the national banks alone having capital, surplus, undivided profits, and deposits aggregating $10,925,000,000.

Under the Federal reserve act of 1913, national banks are permitted to establish branches in foreign countries. This provision is of importance in building up our foreign trade equal to that of the acceptance privilege. Under this provision the National City Bank of New York has established branches in Buenos Aires, Rio de Janeiro, Sao Paulo, Santos, Montevideo, and Habana. It is intended to establish other branches in other countries as rapidly as possible. Great credit should be given the National City Bank for taking the lead in actually placing its own branches in other countries, thus providing our exporters with added facilities for doing foreign business.

In thus establishing branch banks in foreign countries we are following the lead of England, Germany, and the other European countries which have used their banks as trade outposts. European exporters have been able, because they had their own banking institutions on the ground, to extend credits to their customers, when such credits were deserved. Our exporters have been hampered by the lack of these facilities; but more important than this, the documents containing often the most confidential facts of our merchants and manufacturers have been open to the scrutiny of our competitors.

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It has been a rare sight to see letters of credit or bills of exchange drawn in dollars. Usually the American merchant has done his business in pounds sterling, often paying the cost of the conversion in making his purchases. The inauguration of branch banks obviates the necessity of this practice and makes it possible to do business in dollars. With an increasing volume of dollar exchange and with an increasing number of branch banks and American banking institutions, dollar exchange will become more stable. At present dollar exchange is preferred in the money markets of the world. Whether it will be after the restoration of normal conditions in Europe remains to be seen.

It has been suggested, however, that the Federal reserve act, in spite of its many excellent provisions, somewhat hampers and restricts the banker located outside of New York. It is obvious that the volume of exchange in cities other than New York does not warrant the establishment of branch banks in foreign countries. It would be folly for a Buffalo or Seattle bank to establish a bank in Montevideo or Lima, but banks in Buffalo and Seattle, combined with other banks in Cleveland, Cincinnati, Detroit, New Orleans, Omaha, St. Louis, Chicago, and other cities, will together have enough business to support branches in foreign countries. A proposal initiated by the Illinois Bankers' Association has been made to so amend the Federal reserve act as to permit banks throughout the country to interest themselves directly in foreign trade. This can be done either (1) by permitting national banks to establish cooperative branches in foreign countries, or preferably (2) by permitting national banks to hold stock in a purely over-seas bank.

In the matter of financing our foreign trade we seem to be making headway, but we can never hope to realize the really big prizes in foreign trade until we are prepared to loan capital to foreign nations and to foreign enterprise. The big prizes in foreign trade are the public and private developments of large proportions, as, for example, the building of railroads, the construction of public-service plants, the improvement of harbors and docks, the digging of canals, and many others which demand capital in large amounts. New countries are generally poor. They look to older and richer countries to supply them with the capital to make their improvements and to develop their resources. The country which furnishes the capital usually sells the materials and does the work. In the last analysis it comes to this: The country that wants the business must finance the purchases, since the improvements will be made and the materials paid for out of the money loaned. The same thing is true, but less directly, in the case of Government loans. But there is no doubt that the loans of one nation to another form the strongest kind of economic bond between the two. It is commonly said that trade follows the flag. It is much more truly said that trade follows the investment or the loan.

EDUCATION OF MEN FOR FOREIGN TRADE.

The other problem of commanding importance in the development of our international commerce is the education of men for foreign trade. It is absolutely necessary that we train men to carry on our

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foreign trade, for we find ourselves to-day without an adequate supply. This problem may be regarded as the very fundamental of success in this field. Our banks can not establish branches because they have not the men with which to man them. Our manufacturers find it difficult to secure salesmen. Our investors can not find competent advisers on foreign offerings.

Perhaps the most discouraging feature in this problem is that the leaders in our schools and colleges seem unable or unwilling to see the need, or, having seen it, are unable or unwilling to give the thorough instruction necessary. If ever the educator had a definite, concrete problem to solve, it is this. Up to the present time there are no appreciable results. Several of the commercial schools and colleges are giving excellent instruction to young men intending to engage in business in this country, and some are offering good courses in foreign trade. But these courses have not been grouped so as to give the all-round training necessary for success in export trade; the language work is inadequate, and no opportunity is provided to acquire the requisite practical experience.

At one institution a novel step has been taken and a promising plan is ready to be put into operation. New York University has announced the creation of a limited number of special business fellowships for the purpose of training men for foreign trade. These fellowships are awarded by business concerns to men selected from a large number of applicants throughout the country. The plan is to employ the men on a part-time arrangement in the New York offices of these concerns and let them spend the remainder of their time in study at New York University. During the summers, which would ordinarily be devoted to vacation, the men will be expected to devote their entire time to the work of the business concerns employing them. For this half-time work they are to receive from $60 to $75 per month, and the course of training will usually last three years, though each man must of course adapt his training to the need of his employers. It is also expected that the men will live in clubs located near the university, each club devoted to the study of one foreign language. During the coming year there probably will be 25 to 30 men studying and working on this basis, and a rapid increase in the number is expected in the future.

Other colleges and universities, even those having highly developed schools of business, are doing too little to train men for foreign trade. Perhaps this is to be expected, because the demand for such training is of recent origin. Nevertheless, the mere offering of one or two courses on the subject of foreign trade, foreign tariffs, or South America, is absolutely inadequate. When compared with the thorough and careful training which Germany has given her foreign representatives, our work is lamentably inadequate.

It is also to be regretted that the actual work of instruction is not intrusted to men who have some practical or personal knowledge of the subject. A mere second-hand acquaintance, a mere book knowledge of foreign trade, is inadequate. I do not mean by this statement to advocate the employment of merely practical exporters as instructors. But I do advocate the employment of men who have gathered their facts and information by personal investigation, and have thus acquired a first-hand knowledge and have a practical contact with the things which they propose to teach.

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Nor is the criticism of our methods of training men for foreign trade confined solely to the university or business school. The secondary school and college should greatly improve the present inadequate training in foreign languages. Many candidates for positions in this Bureau, who have had several so-called "years" of French, German, or Spanish, fail entirely when subjected to a moderately difficult test. As a matter of fact, it seems well-nigh impossible for a student to acquire an adequate knowledge of a foreign language in our colleges under present methods.

The problem of training men for foreign trade, then, forces us back to the very fundamentals of our educational methods and reveals their weakness in face of a definite, specific task.

When we shall have solved these two problems we shall have gone a long distance toward a successful development of foreign markets. But these two are not the only problems before us; there are other problems which must also be solved along with the two on which special emphasis has been placed.

COMMERCIAL POLICY.

The people of the United States, not alone the business community, are acquiring an international point of view. The great European war has forced the United States into a more active position in the arena of nations, it has forced a clarification of our popular ideas as to our position as a world power, it has forced a delineation and expansion of our international policies, and it has brought us to a full realization of the inadequacy of many of our theories as to our position with reference to the rest of the world. A foreign commercial policy for the United States is gradually taking shape under a wise and careful administration. American investments abroad are being encouraged. The fact that investment must precede trade and that investments abroad must be safeguarded is fully recognized.

But after all, the continuing of a foreign commercial policy on the part of this Government is not so much dependent upon the officers of the Government as it is dependent upon the American public—upon public opinion—and the American public is just awaking to a realization of the situation. The business community likewise is just awaking to a realization of the importance of such a policy to the extension of business. Questioning as to the value and utility of foreign trade is giving way to enlightened study and exploitation. Those who only a short time ago were apt to declare that domestic markets were large enough are chafing under restraints of temporary handicaps in developing foreign markets. Altogether, the business community and the public desire to shake off our commercial dependence on Europe and to establish ourselves commercially independent. This desire finds expression in the public interest in international affairs and in our own foreign policies.

It will not be long before the American public will see the necessity and importance of our foreign relations. It will not be long before our investors will demand a careful oversight of their foreign holdings. Every development of foreign policy will then be judged on the basis of its economic implications. Our national economy is gradually enlarging.

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Our international commercial policies should not be subject to the vagaries of political changes. Our foreign policy in regard to commerce should be so thoroughly American that it would be consistent, and constantly directed toward extending our commercial interests. The intelligent support of our National Government in the international trade is the sine qua non of foreign trade on a large scale.

REVISION OF COMMERCIAL TREATIES.

It is eminently proper, in view of the fact that the Bureau of Foreign and Domestic Commerce is that part of the Government entrusted with the promotion of foreign trade, that a suggestion should be made regarding one feature of trade promotion that has been almost entirely overlooked.

We have utterly failed to make use in our foreign trade promotion of the machinery of the conventional tariff system, which our competitors have employed with great success. We have been satisfied to get most-favored-nation treatment from foreign countries, or, in other words, tariff concessions adapted to the needs of other countries and not to our own. Other countries, by mutual tariff concessions, have gained valuable markets for the goods which they are peculiarly fitted to manufacture for export. Such concessions in the aggregate make up a conventional tariff. This is a matter which is entirely outside the discussion of a protective tariff, a tariff for revenue only, or free trade. A conventional tariff system may be based on a high or a low tariff and is to be regarded solely as a method of promoting foreign trade.

Before a commercial treaty of any importance can be intelligently negotiated there must be collected and collated a vast body of material, having to do not only with a few articles or products of each country which may be in question, but also having to do with other articles and products which may be indirectly affected and with other countries and their relations to our own. This Bureau is naturally and properly called upon by the Department of State to supply much of this information.

In this connection it would be well for us to take account of the fact that the commercial treaties of the most important countries will be largely recast as a result of the European war. Already we find ourselves in a very disadvantageous position in respect to our trade with some of the countries now at war, whose conventional tariffs have been greatly affected by the suspension of their treaties with Germany and Austria-Hungary. This is not a day too early for us to begin preparations for the negotiation of commercial treaties. In fact, such treaties can not be intelligently negotiated without adequate preparation and a definite commercial policy. It will take a considerable amount of time and hard work to make suitable preparation for the task. The necessity of providing this Bureau and other branches of the Government with the means required for preparing, in an intelligent and adequate manner, the basic material for the negotiation of commercial treaties is therefore earnestly urged.

MERCHANT MARINE.

The problem of establishing an American merchant marine is another important item in the development of our foreign trade.

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Just at present business men of all classes, who a little while ago were apathetic, feel the pinch of being compelled to ship in foreign bottoms, and sometimes they can not find any bottoms in which to ship their products. The exporters, the manufacturers, and the farmers meet on this common ground. Practically every American industry feels the need of shipping and feels it keenly. In addition to these considerations, the object lesson abroad has shown us the necessity of having vessels in time of war.

In discussing this matter, however, we should recognize clearly that these are not normal times, that a large number of the merchant vessels of the world have been withdrawn from the ordinary uses of commerce and have been placed at the disposal of the belligerent nations for belligerent purposes. In providing, therefore, for our present necessities we must not forget that with the return of normal conditions the available world's shipping will greatly increase. In view of this, our remedies and plans should be based on a very careful study of the situation in times of peace.

COOPERATION IN FOREIGN SELLING.

Another proposition which has been put forward recently is that American concerns should be permitted to cooperate in developing foreign markets, a thing which many people think is prohibited under our present antitrust laws. It is quite true that the expenses of developing a foreign market are considerably larger than those in developing a domestic market, and it is equally true that a foreign market once developed is much easier to hold against new competitors than a domestic market. These facts put the small manufacturer who wishes to engage in foreign trade at a very serious disadvantage. He is not only unable, on account of limited resources, to develop properly a foreign market, but if he is prevented from developing that market until his larger competitors obtain a foothold, it becomes practically impossible for him ever to develop it. The proposal is, therefore, that these manufacturers be permitted to combine and to develop their foreign markets through cooperative or joint action.

There seems to be little possibility of building up dangerous combinations so long as it is possible for manufacturers to join voluntarily in these associations and so long as these combinations are prevented from becoming absolutely exclusive. It would seem to be the part of wisdom, therefore, at this particularly critical moment in the development of our foreign trade to extend this privilege by definite enactment or interpretation to manufacturers desirous of combining with other manufacturers for the development of foreign markets.

FREE PORTS.

A strong demand for free ports in the United States, modeled after those of Hamburg and Copenhagen, has recently arisen. I fear, however, that there is some misunderstanding on the part of the general public as to the exact nature of a free port. It is not a port, as many otherwise well-informed people seem to think, where goods can be brought into a country free of duty, or where, in some way, the ordinary tariff duties are waived. A free port is a zone within which goods may be transshipped, repacked, stored, or even manufactured, without payment of duty and, more important still, relieved of all annoyance from customs supervision. Naturally such

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goods must pay the regular duties when moved from the free zone, which is a very limited one, into the country proper. The system approaches that of the bonded warehouses in the United States, but does away with the formalities required to safeguard the Treasury and has certain added privileges, such as placing the goods on exhibition or repacking to suit the needs of the market.

The advantages of free ports can, to a degree, be obtained by further liberalizing the present bonded warehousing system, the practice of manufacturing in bond, and the drawback regulations. The changes required can be made in the main by Treasury order, supplemented perhaps by minor change of law.

The free port, however, is to be preferred, because of the consequent centralization of export and import establishments and the advertisement of the port and its convenience as a transshipment point. Such a free port at New York, or on the Gulf, or in the Canal Zone, or on the Pacific coast, or possibly at Manila, would undoubtedly be of great service to the United States in stimulating international trade.

Our customs regulations are extremely lenient when compared with those of most other countries and the fees prescribed are few and moderate. Manufacturing for export in our own country is associated very closely with manufacturing for the domestic market. So far as a factory using imported raw material operates both for the domestic and the foreign market, it is economically barred from location in a free zone, for the share of its output intended for domestic consumption would then be dutiable at the rate fixed on the manufactured article instead of the lower rate on the raw material. Our transshipment trade prior to the European war was small compared with our total foreign commerce. The transshipment trade, which is undoubtedly growing and which will rapidly increase if the United States, and particularly New York, becomes a great center of international trade, is the principal reason for urging the establishment of a free port. It has been found abroad that the free port is a powerful magnet to shipping and the development of the carrying trade.

COMMERCIAL PREPAREDNESS.

There are many other features in the general situation which concern us and which might more properly be made the subject of a report. On the whole, I believe that the events of the last year have raised the United States from the position of a commercially provincial and secondary power to the rank of first importance among the great nations of the world—economically, industrially, financially.

The keynote of our foreign trade at the present moment, and in view of the present international situation and our present opportunity, should be preparedness.

The war gives us certain obvious advantages, many of which are temporary and will disappear after the signing of the peace treaty. Many people believe that we will be confronted with competition even more intense than that which existed before the war, and that we will face industries better organized than our own and spurred on by necessity.

Can we meet the situation unprepared? Can our industries, without large experience in foreign trade, jump suddenly into the world's

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markets and successfully usurp the positions once held by our older and more experienced competitors? Or do we need to organize and gather our commercial forces, and to place the nation's full strength behind men of shrewd and far-seeing intelligence? Without commercial preparedness we will be powerless to take advantage of the greatest opportunity which ever came to any nation.

II.

DOMESTIC SITUATION.

DYESTUFF INDUSTRY.

During the past year the Bureau has taken an active interest in the dyestuff situation. One of the first results of the war which seriously affected American industry was the cutting off of our supply of artificial colors. The coal-tar dyestuff industry has been largely concentrated in Germany, where it has developed to marvelous proportions during the past half century. Approximately 90 per cent of all the dyestuffs now used in the world were made in Germany or from German semimanufactured products. It was, therefore, a severe blow to the numerous highly organized textile industries and also the other industries, such as those of paper, leather, ink, etc., vitally dependent upon dyestuffs, to be cut off from the source of their supplies. Under date of January 26, 1915, the Senate of the United States passed the following resolution:

Resolved, That the Secretary of Commerce be, and he is hereby, directed to inform the Senate as fully as possible as to the facts relating to the supply of dyestuffs for American textile and other industries, the sources of such supply, the extent and nature of the supply, the movement of prices, the available materials for the manufacture of such supplies in this country the possibilities, if any, as to the stoppage of such supply by reason of the existing European war, and any and all such other facts as will bring the existing conditions in the aniline color industry fully to the knowledge of the Senate.

This was referred to the Bureau, and Dr. Thomas H. Norton, formerly connected with the Consular Service, and an expert chemist, who has made special investigation of the German chemical industries, was engaged for the purpose of making a study of the situation and submitting a report to the Secretary of Commerce. The report prepared by Dr. Norton showed, beyond a doubt, that foreign firms not only manufactured the chief part of the dyestuffs which are used in the United States, but that they had used various means, which would probably not be permitted to domestic producers under American laws, to retain control of the market and to prevent the entrance of American rivals into the field of competition. The publication of this report focused public opinion on the subject. The matter has since been referred to the Federal Trade Commission, and it is hoped that, in the interest of American economic development, Congress will take steps to prevent unfair competition on the part of foreign manufacturers with our American industries. It seems to be a matter of imperative importance that a course which is not permitted to rival American firms should be forbidden to foreign competitors doing business in this country.

During the past six months a large amount of American capital has been invested in plants for the production of coal-tar crude compounds, of intermediates, or semimanufactured products, and of finished dyestuffs. A much larger amount of capital is ready for investment should the possibility of unfair competition at a later

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date on the part of foreign producers, by underselling, etc., be removed.

During this period of hurried expansion, to meet as rapidly as possible the urgent demands of American consumers of dyestuffs, the Bureau has been in constant touch with all the factors concerned. It has furnished a large amount of much-needed information to inquirers who have appealed to it for assistance, personally or by letter. By correspondence and by direct visit to all dye-producing establishments, it has been possible to do much to facilitate the growth of the young industry and to bring manufacturers and consumers in touch with one another.

Further measures are planned to aid materially the healthful and economic expansion of this phase of chemical manufacture, hitherto lacking, to complete the cycle of great, national industries, so that it may be permanently established on American soil and utilize thoroughly our abundant and hitherto wasted coal-tar by-products.

INDUSTRIAL INDEPENDENCE.

Additional consequences of the war which have come to the attention of the Bureau have enabled it to facilitate in a notable degree an increasing independence of other branches of American industry. There are many products which were formerly made in Europe and imported into the United States, but which have not been manufactured in the United States. In many cases the knowledge and skill for such manufacture here is absolutely lacking. The European war has, however, completely cut off our supplies of many of these products and has forced American consumers either to manufacture their own supplies or to look elsewhere than the accustomed markets.

III.

NEW WORK UNDERTAKEN.

COMMERCIAL ATTACHÉ SERVICE.

Undoubtedly the most important development in the Bureau's work during the past fiscal year has been the inauguration of the service of commercial attachés. This service was made possible through an appropriation of $100,000 granted at the second session of the Sixty-third Congress. The appropriation has been utilized to place 10 commercial attachés in the principal commercial centers of the world. The centers selected and their respective territories are as follows:

London	The United Kingdom.
Berlin	Germany, Netherlands, Denmark, Norway, and Sweden.
Paris	France, Spain, Portugal, Switzerland, and Belgium.
Petrograd	Russia.
Buenos Aires	Argentina, Paraguay, and Uruguay.
Peking	China and Japan.
Rio de Janeiro	Brazil.
Lima	Peru, Ecuador, and Bolivia.
Santiago	Chile.
Melbourne	Australia and New Zealand.

The appointments to these positions as commercial attaché were made only after severe written and oral examination, conducted under the direction of the Secretary of Commerce by the Bureau of Foreign and Domestic Commerce, in cooperation with the Civil Service Commission and the Department of State. Four of the appointments were made from among officers of the Department of

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State and of the Department of Commerce whose experience in actual commercial promotive work had been large. Of these four, Mr. Baldwin was formerly Chief of the Bureau of Foreign and Domestic Commerce, Messrs. Baker and Arnold were consuls, and Mr. Thompson was a commercial agent investigating trade conditions in Europe. The 10 commercial attachés, their stations, and salaries are as follows:

A. H. Baldwin, London	$5,000
Erwin W. Thompson, Berlin	5,000
C. W. A. Veditz, Paris	5,000
Henry D. Baker, Petrograd	5,000
Albert Hale, Buenos Aires	4,500
Julean H. Arnold, Peking	5,000
Lincoln Hutchinson, Rio de Janeiro	4,500
A. I. Harrington,[a] Lima	4,000
Verne L. Havens, Santiago	4,000
William C. Downs, Melbourne	4,500

Before departing for their posts the attachés visited the important commercial centers of the United States and conferred with manufacturers and exporters. Most of them spent some time at the branch offices of the Bureau and acquainted themselves with the methods of handling work in those offices. For the first few months after reaching their posts the attachés devoted considerable time to establishing their offices and getting acquainted with the various officials of this Government and of the foreign countries, thus preparing the way to prosecute their work with vigor.

The cordial cooperation of the diplomatic and consular officers enabled the commercial attachés to secure temporary quarters with either the embassies or the consulates. It is planned, so far as practicable, however, to have the attachés open separate offices, preferably in the business districts of the cities in which they are located.

The work undertaken by the attachés has differed according to the conditions which each has encountered. The service is a new departure, and its activities have been and will be determined not only by instructions from the Department but also by the individual initiative of the attaché. By arrangement with the Department of State the Department of Commerce is kept regularly informed of the work being undertaken by the Consular Service, and the Department of Commerce also informs the Department of State of the work undertaken through the attachés. In this way any duplication of service is avoided.

On account of the unusual conditions in Europe caused by the war Mr. Thompson has been temporarily stationed at Rotterdam and The Hague. He has devoted almost his entire time to the assistance of importers and exporters, both in this country and abroad, who are engaged in American commerce. The unusual difficulties caused by the regulations of the different belligerent countries presented many problems which he was in a position to assist in solving. He has kept thoroughly posted on the regulations governing shipments of goods to and from European countries, and particularly the Netherlands. Mr. Thompson has been of invaluable assistance to American exporters, especially the cotton shippers, and to American importers who, after purchasing goods from foreign countries, had difficulty in getting them shipped to the United States.

[a] Resigned Aug. 15, 1915.

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At the request of the Spanish Government, transmitted to the Department of Commerce through the Department of State, that a commercial representative of this Government be sent to Spain, Mr. Veditz, before proceeding to his post at Paris, made a month's visit to Madrid. There, in company with the American Ambassador, he conferred with the King and discussed many questions with reference to reciprocal trade relations between the United States and Spain. In the course of the interview Mr. Veditz mentioned the fact that American coal was at a serious disadvantage in the Spanish markets owing to the Spanish transport tax. Three weeks later the Spanish transport tax on coal was removed. This opens up the Spanish market to American producers, a market estimated to be capable of taking under present conditions about 3,000,000 tons of American coal annually. Mr. Veditz has been engaged both at Madrid and Paris in attending to a number of other matters and in assisting representatives of American manufacturers to establish relations with dealers and importers in Spain and France.

Mr. Arnold has shown particular interest in opportunities for investment of American capital in the undeveloped mineral resources of China. Another work in which he has taken an active part is the organization in Shanghai of an American Business Men's Club, which will bring together the American colony in that city and the representatives of American concerns, something which has heretofore been lacking. He has also taken over the library of the consulate general at Shanghai and proposes to establish a similar commercial library at Peking.

Mr. Arnold has under way the preparation of a handbook on China, which will be one of the series the Bureau is publishing. He is visiting the important trade centers in China and will be one of the first of the attachés to return to the United States for the purpose of advising and conferring with manufacturers.

Mr. Hutchinson at Rio de Janeiro has devoted nearly his entire time to a study of the tariff and the financial situation in Brazil. This work was undertaken in view of the proposed revision of the tariff, in which American exporters are much interested because of the effect any revision will have on the exports of our products to that country.

Mr. Harrington has devoted most of his time to a study of the tin situation in Bolivia, and has been assisting certain American concerns to obtain contracts for sufficient tin ore to warrant the establishment of a tin smelter in the United States. Up to this time no tin has been smelted in the United States, in spite of the fact that the United States is the largest consumer of tin in the world. All the Bolivian tin and the Straits Settlements tin has gone to Europe, particularly to Germany, England, and Belgium, and has there been smelted and reexported to the United States. If the proposition on which Mr. Harrington has been engaged works out successfully, this tin will be brought to the United States, smelted here, and used or exported, as conditions may warrant. It will mean a total addition in exports and imports to our foreign trade probably not much short of $50,000,000 per year.

One of the greatest difficulties encountered by the Bureau in connection with the commercial attaché service is that of obtaining competent clerks for the commercial attachés. The lack of men trained

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for this work emphasizes the need of men equipped for foreign service in general. One of the drawbacks, as has already been emphasized in another part of this report, in our efforts to increase the foreign trade of this country, is the lack of men with the proper training. The clerks to commercial attachés are required to have a knowledge of the language of the country to which they are appointed and also a knowledge of stenography and typewriting. These positions were all filled after considerable difficulty by special examinations held by the Civil Service Commission.

A feature of the commercial attaché work for the first year of its existence will be the collection of a series of reports on the hardware trade of the world, made possible by special provision in the appropriation for commercial attachés, authorizing the purchase of reports by the attachés. A certain sum has been allotted each attaché for the purchase of reports from local experts and also a sum for the purchase of samples illustrating either specimens of hardware manufactured in that country and used for export, or specimens of hardware actually consumed in the country and imported from various foreign countries. To the attachés has been especially intrusted the supervision of the preparation of these reports and the purchase of whatever samples and illustrations may be necessary. This is the first world-wide investigation of this character that has been undertaken by the Bureau, and if found of practical value to the business community the same method is likely to be used in the future for similar reports on other subjects. The samples collected will form the nucleus of a permanent exhibit which the Bureau purposes to establish in New York City.

It is planned to provide for the regular return of two to five of the commercial attachés each year. In this way the attachés will be able to meet manufacturers and exporters and to ascertain at first hand their needs and desires. It will also be possible for the American attachés to give out information with reference to their districts. Thus they will perform a function which will be far more useful than the written reports they may make or the correspondence they may have with interested American firms. The wording of the appropriation made it impossible for the Bureau to employ any administrative assistance in Washington, and it has therefore been necessary to withdraw from his regular work one of the Bureau editors and place him in charge of this work. It will be necessary later to provide for considerable clerical assistance to handle the commercial attaché work, which is rapidly increasing.

ADDITIONAL BRANCH OFFICES.

During the past year the system of branch offices of the Bureau has been considerably expanded. New offices have been established in Boston, Atlanta, Seattle, and St. Louis. In addition to these there are also branch offices located in New York, Chicago, New Orleans, and San Francisco, which were established during the preceding fiscal year.

The function of a branch office is not merely the distribution of the information published or distributed through the Bureau of Foreign and Domestic Commerce; rather, it is aimed to establish a service which it is impossible for the Bureau at Washington to render. The branch officers come in personal and close contact with

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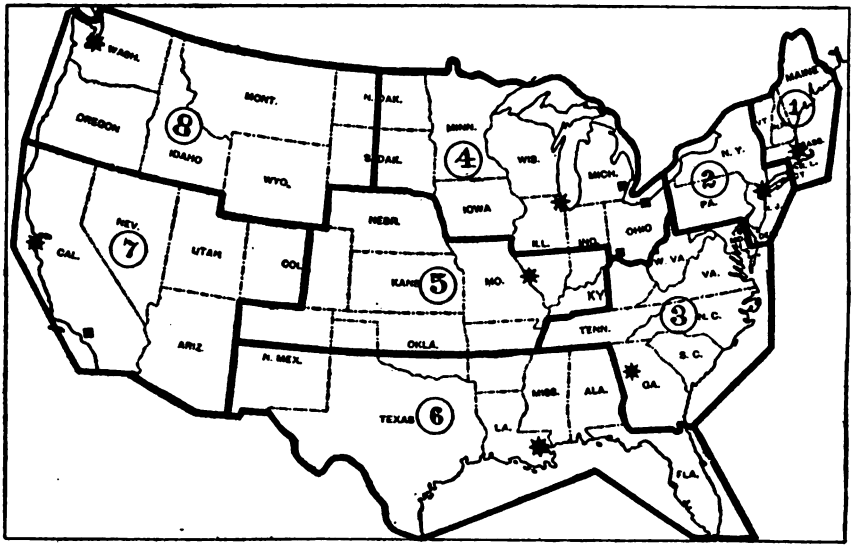
business men in all parts of the country and they interest the local manufacturers in foreign trade and instruct them how to proceed.

The branch offices must, of course, be located in certain cities, but it is not the intention of the Bureau that these offices shall serve only the cities in which they are located. In fact, there has been assigned to each office a definite territory and the official in charge of the office is expected to visit all the principal exporting centers in that territory. A map indicating the territory which has been assigned to the various branch offices accompanies this report, and shows the distribution of the country among the different offices.

That these branch offices are filling a real want on the part of American business men is daily attested by communications which reach this Bureau bearing tribute to the excellent work performed



DISTRICT OFFICES OF THE BUREAU OF FOREIGN AND DOMESTIC COMMERCE.

* Indicates headquarters of each district: 1, Boston; 2, New York; 3, Atlanta, 4, Chicago; 5, St. Louis; 6, New Orleans; 7, San Francisco; 8, Seattle.
■ Indicates cooperating offices: Cincinnati, Cleveland, and Detroit, in district 4; and Los Angeles, in district 7.

by the commercial agents in charge. The work of these offices has greatly increased during the past year and in many additional assistance has been required. One of the principal features of the work performed is the arranging of conferences between American business men and consular officers and special agents who have returned to the United States from foreign countries. Such conferences have been productive of large practical results. Another work of great importance is that of placing foreign buyers in direct touch with American business men able to supply their needs. In many cases sales of goods amounting to hundreds of thousands of dollars have been made as a result of the assistance given by branch offices to foreign merchants.

The commercial agents in charge of the branch offices have also rendered excellent service in making special investigations desired by the Bureau. They are frequently called upon to address meet-

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ings of commercial organizations, such as chambers of commerce and boards of trade, also to address classes at universities, Young Men's Christian Associations, and other institutions interested in export trade.

The establishment of additional branch offices is extremely desirable, but at present apparently impossible. It is not the intention of the Bureau to establish more branch offices under the present appropriation or under that recommended to the next Congress.

COOPERATION WITH COMMERCIAL ORGANIZATIONS.

Added facilities are absolutely necessary in order to effectually serve the business community. The Bureau has accordingly decided to extend to any commercial organization which is willing to subscribe to the conditions imposed exactly the same information and service as it furnishes to its own branch offices. Under this cooperative plan it will be possible for any chamber of commerce in the country sufficiently interested in foreign trade to establish a foreign trade bureau and to furnish to its members and to the local community the same information in the same form and with the same speed that such information is given out by the branch offices of this Bureau.

The exact plan under which this is to be carried out is outlined as follows in a letter written to the Cleveland Chamber of Commerce:

The Bureau of Foreign and Domestic Commerce is now ready to proceed in establishing on a working basis the plan of cooperation which is outlined below. The conditions of such cooperation can perhaps best be stated by outlining briefly just what will be expected of the Cleveland Chamber of Commerce and what the Cleveland Chamber of Commerce may expect from the Bureau of Foreign and Domestic Commerce. These points may be summarized under two heads and are as follows:

WHAT THE CLEVELAND CHAMBER OF COMMERCE IS EXPECTED TO DO.

(1) The Cleveland Chamber of Commerce shall establish a foreign trade bureau.

(2) This foreign trade bureau shall be under the direction of the board of directors of the Cleveland Chamber of Commerce, which shall be given power on behalf of the Cleveland Chamber of Commerce to enter into such agreements as may be necessary.

(3) The executive direction of this work shall be in the hands of a man who shall devote his entire time to it, and he shall be provided with such clerical assistance as may be necessary to prosecute his work effectively.

(4) The work which is being carried on shall at all times be open to the inspection of the officers of the Department of Commerce.

(5) The foreign trade bureau shall render regular monthly reports in a form to be prescribed by the Bureau of Foreign and Domestic Commerce.

(6) The foreign trade bureau shall make at its own expense a complete copy of the "Exporters' Index" for Cleveland and immediate vicinity. This index shall be kept up to date and additional data transmitted to Washington.

(7) The foreign trade bureau may be called upon to make reports on specified subjects. It is understood, of course, that such service will not be called for to any considerable extent.

(8) The foreign-trade bureau will be expected to receive and entertain (arrange conferences and meetings for) visiting commercial attachés, commercial agents, and consuls on leave in this country.

(9) The service rendered by the foreign-trade bureau will not be restricted to the members of the Cleveland Chamber of Commerce, but will be freely given to all citizens residing in or near Cleveland.

WHAT THE BUREAU OF FOREIGN AND DOMESTIC COMMERCE IS WILLING TO DO.

(1) The Bureau of Foreign and Domestic Commerce will place at the disposal of the man who is delegated to do this work every facility of its Washington

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office and of its branch offices for the purpose of study. This will enable him to gain a complete idea of the facilities which the Bureau has to offer and will also put in his hands the tools with which to work.

(2) The Bureau of Foreign and Domestic Commerce will furnish the local bureau with all the information which it distributes. This will include: (*a*) The details and addresses of "Foreign trade opportunities"; (*b*) photostatic copies of plans and specifications which have been sent heretofore only to branch offices of the Bureau; (*c*) all confidential circulars issued by the Bureau; (*d*) telegraphic trade opportunities which have been received by cable.

(3) Ordinarily the information which the Bureau can furnish in answer to an inquiry is arbitrarily limited. This is necessary not only on account of the great volume of requests but also because of the limited force of the bureau. On account of the large number of manufacturers who would be reached through the local organizations, requests from the local organizations will receive more detailed and unlimited attention.

(4) The Bureau of Foreign and Domestic Commerce will furnish the Cleveland Chamber of Commerce with a complete, so far as available, set of the publications of the Bureau.

(5) The Bureau will provide, in cooperation with the Superintendent of Documents, in the Cleveland Chamber of Commerce a supply of its publications which are for sale and which will convenience local manufacturers in obtaining desired information.

(6) All samples which are received by the Bureau from its agents in the field will be sent on regular schedule to the Cleveland foreign-trade bureau for exhibition.

It is understood between us that the Bureau of Foreign and Domestic Commerce may withdraw from this arrangement at any time, and for any reason whatever, upon notice. The same privilege is extended to the Cleveland Chamber of Commerce.

It is understood that you will place in charge of this particular department of your work a man who can satisfy the Bureau of Foreign and Domestic Commerce that he is qualified to do the work and who is satisfactory to us. We will then be prepared to put the plan into operation at once.

Upon your certifying your willingness to proceed with this plan, we will employ in Washington a competent clerk to make a transcription of the section of the "Exporters' Index" referring to Cleveland and vicinity. This will be sent to you immediately upon completion.

There will undoubtedly arise many questions which will have to be settled from time to time. It is my hope, however, that this plan will be fruitful of results in building up the foreign trade and commerce of the city of Cleveland.

Upon formal confirmation of this letter by order of your board of directors, this plan will go into effect.

Up to date, three organizations have indicated their interest and have subscribed to the conditions and are now being furnished with the complete service of the Bureau. These organizations are the Cleveland Chamber of Commerce, the Cincinnati Chamber of Commerce, and the Los Angeles Chamber of Commerce.[a]

Some of the railroads, to stimulate the development of export business, have already established a special foreign trade service. The railroads have recognized the advantage, and have accordingly set their machinery to work, in soliciting and building up export business along their lines. The Bureau is willing to extend to any railroad establishing a special foreign trade department the information which it would ordinarily furnish only to one of its own branch offices, and it is hoped that, with the aid of the great staff of freight solicitors which the railroads employ, it will be possible to interest personally a very large number of American manufacturers who have not heretofore concerned themselves with foreign trade. Up to the present time only one railroad has availed itself of this offer and is now in receipt of our complete service, namely,

[a] Since the close of the fiscal year, the Detroit Board of Commerce and the Philadelphia Chamber of Commerce have accepted the cooperative plan of the Bureau.

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the Cincinnati, New Orleans & Texas Pacific Railway, with headquarters at Cincinnati, Ohio.

COMMITTEE SYSTEM.

No well-organized business can attain its greatest possibilities without securing the assistance and cooperation of the members of its own staff. The same is undoubtedly true of a Government department. As a matter of fact, the accepted principles of business efficiency should be as firmly established in a Government bureau as in a private business. There is naturally a vast amount of work which demands constant cooperation and consultation between different members of the staff of an organization such as the Bureau of Foreign and Domestic Commerce. For this purpose there has been inaugurated in this Bureau a committee system, and from time to time committees will be established not only for the solution of temporary problems but also for handling permanent lines of work as they demand special attention.

An executive committee has been appointed to formulate general policies; this consists of the Chief and the first and second Assistant Chiefs of the Bureau. Perhaps the next most important committee is the appointment committee, which is charged with the recommendation of new appointees and the promotion of old ones, the arrangements for examinations, and various other matters involved in the great volume of work connected with the building up of a growing organization. A very peculiar responsibility rests on this committee, especially in the selection of men to represent this Bureau in foreign fields. It is not such a difficult matter nor so serious a one to select an employee for the Washington office, or for one of the branch offices, where the employee is constantly under the supervision and direction of the officers of the Bureau, but when a man is sent on a special errand to South America or to the Far East and when there is practically no test of his work until he has returned and the work is completed, the task assumes much more important proportions. It is, therefore, to the selection of commercial agents and commercial attachés, and more particularly to the development of a method of their selection, that the appointment committee has given special attention.

Another important committee is the welfare committee, which is the mouthpiece of the employees of the Bureau. All complaints on the part of employees and also suggestions for the improvement of conditions in the office which affect the welfare of the employees are taken up by this committee and recommendations made thereon to the Chief of the Bureau. The committee has been especially engaged with such subjects as cooperative buying, a cooperative credit union, educational classes, particularly in the study of languages, the care of office quarters, etc.

A special committee was appointed to consider and suggest a plan for the reorganization of the research work of the Bureau, and as a result that work has been reorganized and placed on a basis which, it is hoped, will be more efficient and more useful.

APPOINTMENTS BY EXAMINATION.

An important innovation was made in connection with appointments to field positions in this Bureau as a result of an order issued by the Secretary of Commerce under date of January 8, 1915, which

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required that all appointments to the position of commercial agent or special agent on and after January 1, 1915, should be made on the basis of examinations to be conducted, under the auspices of the Civil Service Commission.

Under the terms of this order, arrangements were made for the examination of all candidates for field positions in this Bureau and eight examinations have been held. These examinations are prepared by the Bureau but are conducted under the auspices of the Civil Service Commission. The successful candidates for the more important positions are required to report to Washington for oral examination. It is believed that, as a result of this method, the men who have been taken into the service of the Bureau during the past six months have been of an exceptionally high grade.

I might point out at this point that it is particularly difficult for us to secure men with the kind of training necessary. In the first place, we encountered the greatest difficulty in getting men with a thorough knowledge of the languages required. In addition, it is very difficult to get men, especially for the position of commercial agent, who have a sufficient technical knowledge of the special industries which they are expected to study and are at the same time qualified to report clearly and fully the results of their investigations. It is absolutely necessary that we send out only men who are thoroughly conversant with every technical detail of their subjects. The men whom we employ for this work must be experts among experts. With these rather stringent requirements and with the modest compensation and short term of employment that the Bureau can offer, it is not surprising that we find difficulty in obtaining fully qualified commercial and special agents.

IV.

REORGANIZATION OF SPECIAL FEATURES OF WORK.

REORGANIZATION OF "DAILY."

One of the most important improvements which has been made in the work of the Bureau during the past year has been the reorganization of the scheme of publication of what was called prior to January 1, 1915, "Daily Consular and Trade Reports." The name was changed on the 1st of January to "Commerce Reports." The end in view was not a mere change of name but to inform people, who had been in the habit of thinking of the Daily Consular and Trade Reports as out of date and hence of limited usefulness, that there had been a change. This change was not so much one in the character of the material as in the speed with which that material reached the business public.

There was a time when the reports were considerably delayed in the Department of State, and after being sent to the Bureau they might remain there in process of editing for a considerable period, perhaps two weeks, perhaps a month or more. They were then likely to be in the hands of the Public Printer for a considerable length of time. It was possible, beginning with the issue of January 2, 1915, through the cooperation of the officials of the State Department and the Public Printer, to inaugurate a very rapid—practically a newspaper—service in connection with Commerce Reports. Under the present arrangement telegraphic dispatches received at the Department of State are sent by messenger immediately to the Bureau of Foreign and Domestic Commerce. Dispatches arriving at the

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State Department in the morning are in the hands of the editorial staff of the Bureau by 1 o'clock the same day. If important, they are edited and dispatched to the Public Printer at 4.30 p. m. They are printed during the night or early the next morning and are in the mails by 1 or 2 o'clock the same afternoon. It is thus possible for subscribers, within a distance of 18 hours of Washington, to receive their Commerce Reports on the first mail the following morning, and through this medium read dispatches within 48 hours after their arrival in Washington.

The annual reports of American consuls in foreign countries have been the source of considerable difficulty in our editing work. Many of them are lengthy, and since they come in chiefly between March 1 and August 1, it is very difficult to edit and publish them promptly; they must either be put aside to wait a place in the regular issue of Commerce Reports or crowd out other, and what in many cases seems more timely, information. It was therefore decided to publish these annual reports of the consuls as supplements to the "Daily." They are now issued, as rapidly as they come in and can be edited, as supplements to Commerce Reports and are sent out either under the same cover with a daily issue or under another cover. These reports are numbered serially. Each country is given a number and each separate report is given a letter under that number. Country No. 1 is Austria-Hungary; the other European countries follow in alphabetical order, and the other countries of the world follow, each one in its proper grand division. If a consul in Vienna is the first consul in Austria to report, his report becomes No. 1a, and if a little later a consul in Prague reports, his report is No. 1b. It is therefore possible for the subscriber interested in Austria-Hungary or some other country to bind all his reports on that country together and have a complete review of the year's trade. The same is possible for the man interested in other countries or in any one of the grand divisions of the world.

NEW DIVISIONS OF THE BUREAU.

With the constantly enlarging field force of the Bureau the administrative details in the Washington office have become enormous. This is particularly true in connection with the commercial attaché service, the commercial agent service, and the system of branch offices. In each of these cases, therefore, a clerk in the Bureau has been placed in charge and the nucleus of a regular division of the Bureau's work has been formed. There is in existence, therefore, a division of commercial attachés, a division of commercial agents, and a division of branch offices, and all of the routine correspondence is handled through these regular administrative channels. It is absolutely impossible to hope for the highest development of any of these services unless very high-grade men are placed in charge of each one of them, with adequate clerical assistance to keep all the details carefully up to date.

STENOGRAPHIC SECTION.

A considerable change has also been made in the internal arrangement of the clerical staff. It had previously been the custom in the Bureau to assign stenographers to the various divisions with which they had a considerable amount of work. Early in 1915, however, a large part of the stenographic force of the Bureau was concentrated

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in a correspondence or stenographic division. This has proved to be of considerable assistance in expediting the immense correspondence of the Bureau and has resulted in the much fuller utilization of the small staff of stenographers we have at our disposal.

REORGANIZATION OF STATISTICAL WORK.

For many years it has been realized that the methods employed in collecting import and export statistics needed a thorough revision. The system still in use was derived from the old British system and has not been revised to make it accord with the development of modern conditions. Departmental and interdepartmental committees have investigated the subject and have made illuminating reports and presented recommendations. Except in certain questions of detail, however, their recommendations were not made effective.

In October, 1914, Mr. Frank R. Rutter, an Assistant Chief of this Bureau, was instructed to make a detailed investigation of all phases of our statistical service, with the object of putting in practice at the earliest possible date such changes as were found necessary to insure prompt and accurate statistics of imports and exports. Since that time Mr. Rutter has made a most detailed investigation, examining minutely the statistical methods in force at New York, Philadelphia, Baltimore, Buffalo, Detroit, and Chicago, and conferring as widely as possible with business men and Government officials. The recommendations contained in his preliminary report were submitted to two statistical committees, one appointed by the Secretary of the Treasury and the other by the Secretary of Commerce, which met in joint session at this Bureau in June. The conclusions indorsed by these committees have also been referred to the Chamber of Commerce of the United States of America for its consideration.

MECHANICAL TABULATION.

The installation of tabulating machines at the New York customhouse is the most striking instance of the improved statistical methods that have been adopted. After exhaustive tests, first at the Baltimore customhouse, then here at the Bureau of Foreign and Domestic Commerce, and finally at the customhouse of New York, it was found practicable to undertake by these means the tabulation of statistics of imports and exports for the entire country on July 1, 1915.

At the various ports returns for each entry or manifest are made out by statistical clerks on special forms adapted to minimize clerical labor. These forms are transmitted daily to New York, where the data are transferred to punched cards, which are then sorted and tabulated mechanically. The tabulator in use automatically lists the results. The sheets so printed will be transmitted monthly to the Bureau in two series, the first sent in immediately after the close of the month, being confined to the data required for publication in the Monthly Summary of Foreign Commerce of the United States, and the second, to be transmitted later, showing the full details required for the compilation of the annual report.

For the present, collectors of customs are required to continue the usual methods of tabulating and to report their results monthly to the Bureau of Foreign and Domestic Commerce. These reports are hereafter to be made on narrow strips instead of in books, in order to facilitate addition and to minimize the necessity for transferring

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the returns to office books in this Bureau. It is planned to discontinue these direct reports to the Bureau as soon as returns from the tabulating machines are received in due time and with substantial accuracy.

The advantage of the new system lies not in any saving in expense but in furnishing a means of bringing about, without an increase in expenditure, prompter returns and a much larger capacity for statistical work. Heretofore the personnel has been entirely inadequate to the needs of the service. We have consequently suffered both in timeliness and in accuracy. The statistically trained clerks who are relieved from clerical drudgery by the new system must be utilized to scrutinize returns with the utmost care. Otherwise the use of tabulating machines will result, not in more useful information, but in a more rapid publication of misleading information.

STATISTICAL REFORMS AT THE CUSTOMHOUSE.

Other changes in method have been recommended, some of which have already been put into effect. These, while less striking than the installation of tabulating machines, will exert a strong influence toward greater accuracy and increased timeliness. It is realized that improvement must be gradual. Instead of waiting until an elaborate program could be drawn up, it has seemed best to correct first one point and then another in administrative practice. Without question, some changes of law are greatly needed, but it has been deemed wiser to take the immediate step at once instead of awaiting future congressional action.

With the object of making statistics of imports correct from the start, so far as this ideal can be realized, and thus avoid the danger and delay attendant upon the present practice, a statistical examination of the returns is to be made by clerks thoroughly familiar with the import classification before the entry is accepted.

This measure was recommended strongly by the statistical committees of 1911, but because of an inadequate statistical force and the fear that an undue delay in the customs procedure would result, was not actually put into effect. The use of tabulating machines obviates the first of these difficulties. To minimize the second difficulty, it is proposed to require from the importer a separate statistical return, which if necessary may be compared with the invoice after the entry has been tentatively passed.

In the aggregate, statistics of imports are without doubt approximately correct. Individual items, however, show a wide margin of error, which is especially pronounced in two cases, (1) articles free of duty and (2) articles subdivided for statistical purposes more minutely than in the tariff.

On the export side the margin of error is without question very large. The lack of any direct connection with the collection of revenue, which is the primary purpose of customs administration, exempts the articles themselves from any examination and minimizes the scrutiny given to the declarations submitted by exporters.

To accomplish an improvement in the statistics of exports, original shippers should be encouraged to make out their own manifests instead of leaving this task to their agents at the seaport. This pro-

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cedure is now prescribed in case of exports by land, but in the case of exports by sea the documents have to be made out at the port of exportation, since the customs regulations require the manifests relating to exports by vessel to be sworn to before the collector of customs. A recommendation has been made to the Secretary of the Treasury that this regulation be modified so as to permit taking the oath before any notary public. Moreover, a new form of manifest has been drawn up, intended to facilitate the preparation of manifests in the interior. To the manifest is attached a duplicate, which gives a description of the articles but not their value. On such a form the manifest can be made out as well at an interior point as at a seaport. It can be mailed to the collector of customs at the port of exportation where the duplicate can be detached, attested by the deputy collector in charge, and forwarded to the agent designated by the original shipper. It will then serve as evidence that the proper declaration is on file at the customhouse and the ship is at liberty to accept the consignment.

Up to the present there has been no real opportunity to verify the statements in the shippers' manifest. In the case of exports by railway a car manifest is required from the transportation company and in the case of exports by vessel a manifest from the master of the ship. These documents, however, have in almost all cases been copied directly from the shippers' manifest by the transportation company and accordingly present no new data. They constitute, however, a burden upon the carrier. It is proposed to accept, in lieu of the car manifest, a duplicate copy of the way bills covering the shipments and, in case of vessels, a manifest compiled from their own records. A real check will consequently be available in regard to all details of the shipment, with the exception of its value. Given the correct quantity, the accuracy of the value declaration can easily be checked by reference to trade papers.

The measures proposed, some of which have already been put in force, will do much to promote the completeness and accuracy of our export statistics and will further unify the procedure covering exportation by sea and by land. They will also enable customs officials to preserve more fully the confidential character of the information and will relieve common carriers of some unnecessary burden. Above all, they will facilitate obtaining information from the original shipper, who obviously is in a much better position to have accurate information and is in general in closer sympathy with the work of the Bureau of Foreign and Domestic Commerce.

It will, however, be necessary to go a step further. No penalty whatever is now prescribed on the shipper who fails to make the declaration required by law. The penalties imposed by statute apply exclusively in the one case to the master of the ship, and in the other case to the agent of the railroad company. Import penalties which can readily be enforced should, therefore, be prescribed for failure to declare exports or for inaccurate statements or statements that fail to show sufficient detail to permit proper tabulation. These fines should attach to the shipper or his agent, in case the latter furnishes incorrect or inadequate description of goods. The collector of customs, moreover, should be authorized to demand, in case of doubt, the original invoice in order to test the accuracy of the statements in the manifest.

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CLASSIFICATION.

A general reform of the statistical classification is essential, with the object of bringing the export list into closer conformity with the import list and of showing such further details as are required by the business interests of the country. The general subject is so vast and requires such extensive correspondence with the business public that it was deemed best to postpone any important action on this subject until certain fundamental questions of accuracy had been solved and it had been determined to what degree an elaboration of the schedule would be practicable under the new system of tabulation.

A few anomalies in the statistical classification have, however, been corrected. Still more important, the statistical work has been materially lessened by withdrawing the demand for certain data which appear to have no importance at all commensurate with the labor and expense involved in their collection. In this connection it has been decided to combine the value of imports and exports in steam and sailing vessels; to discontinue the distinction between goods landed at the customs district at which entry is made and those transported without appraisement from some other customs district; and to eliminate statistics of imports by mail, which have heretofore been returned very incompletely. The way is thus cleared for the demand for an elaboration of the schedules where most needed. Business organizations of the country are requested to study carefully the statistical needs of the lines of trade affecting most closely their members, so as to be in a position to advise the Bureau on the subject of classification.

FORM OF STATISTICAL PUBLICATIONS.

The publication of commercial statistics for the fiscal year ended June 30 instead of for the calendar year is without question a relic from the period when statistics were designed for the information of the Government instead of the public. In the majority of cases the business man's year is the calendar year, and a source of confusion would be removed if the calendar year were made the basis for our statistics of imports and exports. Their comparability with census returns and with the commercial statistics of foreign countries would also be greatly enhanced. The only difficulty in the way of making the change is the legal provision contained in the organic law of the (former) Bureau of Statistics, which has been consolidated in the Bureau of Foreign and Domestic Commerce.

Another survival of the official view of commercial statistics is found in the distinction between free and dutiable goods that is made in all tables of imports and even in the table of reexports. This distinction is of no significance to the business man, except in the elaborate statement of imports for consumption, contained in Table 9 of the annual report Commerce and Navigation of the United States, where every subdivision of the tariff is shown and the actual rate of duty is cited. Elsewhere the distinction causes much inconvenience. When an article is transferred from the free to the dutiable list, or vice versa, during the period covered by the five-year table of imports (Table 3) in Commerce and Navigation, two separate statements have to be given, interfering materially with easy comparison of the returns for the full period. In the case of reexports, or exports of foreign merchandise, the distinction is meaningless.

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Promptness is, without question, the first requirement in the case of the Monthly Summary of Foreign Commerce. The public has borne patiently the delay in the appearance of these reports, which has been unavoidable on account of the trade disturbance following the outbreak of the war and the increased work placed upon the statistical force at New York by the tests of tabulating machines. For several months it has been necessary, in order to make a thorough test, to compile the returns in duplicate—by hand and by machine. This need, it is confidently expected, will be soon passed and then the public will have the reward of its patience in a prompter publication of the monthly returns than has ever before been possible.

Requests are frequently received for more details by countries in the Monthly Summary. These requests can not be complied with in the majority of instances without a loss of timeliness. If there is sufficient demand for further details by countries, it would probably be better to start a separate publication, giving these returns quarterly. The needed fullness of detail and promptness of publication can not be united in one report.

V.

PROPOSED REORGANIZATION OF THE BUREAU.

On account of the recent rapid growth of the Bureau of Foreign and Domestic Commerce, it has not been possible up to the present to organize the Bureau in the most effective manner. In order, therefore, to make the work more efficient and to specialize the work of the different divisions, a plan of reorganization has been tentatively adopted.

Before taking up the proposed plan of reorganization, it would probably add to the clarity of our exposition to discuss briefly the present organization of the Bureau.

At the head is the Chief of the Bureau of Foreign and Domestic Commerce. There are two assistants—the first and the second assistant chief. Under the first assistant is gathered generally the work of an administrative character, and under the second assistant is gathered the work of a more technical nature. Under the first assistant is the chief clerk's office, with general charge of correspondence, files, accounts, and distribution of publications. The first assistant also has general charge of branch offices, the commercial attaché service, and the commercial agent service. The second assistant has general supervision of the editorial division, the Latin-American section, the cost of production division, the statistical division, the foreign tariff division, and the research section. There is, however, a considerable amount of duplication. For example, it has been found necessary to put the branch offices in immediate charge of the same man who has charge of the trade information section, which is nominally in the editorial division and under the second assistant chief. There are a number of other instances, which are more or less clearly revealed on the accompanying organization chart.[a] It will be seen that there are a number of distinct functions of the Bureau's work which are not clearly defined and are not properly organized into separate divisions.

The proposed plan of organization follows the general lines already laid down; that is, the work which is principally administrative is to

[a] Chart not printed in this compilation.

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be placed in charge of the First Assistant Chief of Bureau, and the work which is primarily technical is to be placed in charge of the Second Assistant Chief of Bureau. This plan of organization is clearly set forth in the accompanying organization chart.[a] Under the First Assistant Chief of Bureau it is intended to place the chief clerk's office, with the various subsidiary sections, and three entirely new divisions, namely, division of field agents, division of branch offices, and division of commercial attachés. Under the Second Assistant Chief of Bureau are to be placed the editorial division, Latin-American section, division of statistics, division of foreign tariffs, cost of production division, research section, and a division which, it is hoped, will be created, the internal commerce division. This plan, it will be readily seen, segregates each part of the work and puts each division under a responsible head. This plan would make the organization considerably more effective.

IMPERATIVE NEED OF ADEQUATE STAFF.

Undoubtedly the most serious need in the Bureau at the present time is additional clerical assistance in the Washington office. The general work of the Bureau, the number of men in the field, the amount of correspondence, the volume of publications, etc., have been steadily increasing during the last few years, but the clerical staff has not been increased to any considerable degree.

The accompanying table (No. 6) gives the number of employees in the Bureau of Foreign and Domestic Commerce during the years 1912 to 1916, and this table shows clearly that in 1912, with a field force of only 11 men, paid out of special lump-sum appropriations, the number of office employees was 92, and that in the year 1915, which is just passed, the number of lump-sum employees was 89, and those holding statutory positions 89. During the year 1916 the force paid from special appropriations will probably reach 96 men, while the number of statutory employees in the office is 86. This indicates clearly that while the volume of work has been steadily and rapidly increasing in order to meet the demands made on the Bureau, the number of positions in the Washington office provided for expressly by law has decreased.

TABLE 6.—EMPLOYEES OF THE BUREAU OF FOREIGN AND DOMESTIC COMMERCE DURING THE FISCAL YEARS 1912 TO 1916.

Year ended June 30—	Employees under lump-sum appropriations.									Regular statutory force of Bureau.	
	Promoting commerce.		Promoting commerce of South and Central America.[b]		Investigating cost of production.[b]		Commercial attachés.		Total lump-sum employees.	Employees.	Appropriation.
	Employees.	Appropriation.	Employees.	Appropriation.	Employees.	Appropriation.	Employees.	Appropriation.			
1912	11	$60,000	.....	.....	.....	.....	.....	.....	11	[c] 92	[d] $110,600
1913	12	60,000	.....	.....	.....	.....	.....	.....	12	[c] 88	[d] 114,860
1914	16	60,000	.....	.....	13	$50,000	.....	.....	29	[c] 88	[d] 114,860
1915	[e] 34	75,000	17	$50,000	18	50,000	20	$100,000	89	89	122,180
1916 *f*	[e] 31	75,000	27	75,000	18	50,000	20	100,000	96	86	119,280

[a] Chart not printed in this compilation.
[b] Exclusive of temporary employees.
[c] Including six employees paid out of tariff appropriation; later transferred to statutory positions.
[d] Including tariff appropriation ($10,000).
[e] Includes two positions in the Bureau provided for by appropriation act
f In part estimated.

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The statutory force has been supplemented to a minor extent by the appointment of some experts and temporary employees paid out of the special lump-sum appropriations providing for such employment. The use of the special appropriations for salaries in Washington has been strictly limited to the very serious situation created by the European war. The correspondence on foreign trade, particularly with reference to Latin America, increased by leaps and bounds immediately after the outbreak of war and, urgent as was the need of our manufacturers and exporters, could not otherwise be handled. As it was, the work piled up and the correspondence and filing got far behind.

Throughout the year a large amount of overtime has been contributed by the employees of the Bureau. It is only by this means that the inadequate staff is able to keep pace with the accumulation of work which must absolutely be taken care of.

The effort has been made to measure the increase in the amount of work done in the various divisions of the Bureau. Thus, the number of separate publications edited, and in some instances compiled, in the editorial division increased from 328 in 1912 to 425 in 1915 and will probably reach 500 in the fiscal year 1916. The printed pages contained in these publications numbered 7,013 in 1912, 10,448 in 1915, and 12,000 (estimated) in 1916. Over 4,000 trade opportunities were published in 1915, against 2,145 in 1912; and over 500 confidential circulars in 1915, against 136 in 1912. Yet during this period the regular force in the division increased only from 10 to 14, and it should be pointed out here that one man's services are largely concerned with directing the commercial attaché service, and another man's time is largely occupied in directing the work of the branch offices. Neither of these men can give any consecutive amount of time to editing, and therefore the work has been especially and unusually heavy on the remaining editors who devote their time to editorial work exclusively.

Special statements of foreign import duties, which constitute a very large part of the work of the division of foreign tariffs, increased over fourfold between 1912 and 1915, from 129 to 558, and probably sixfold between 1912 and 1916, while the number of persons employed increased from 5 to 8. And it is worth while noting in this connection that at least one employee in this division has in recent months been devoting almost his entire time to special matters which have arisen and have seemed to be of imperative importance, and still another employee has been exclusively engaged in the work of gathering and publishing information with reference to trademarks throughout the world. The inadequacy of the staff, in the face of growing demands for specific information, has resulted in restricting the formal publications of the division. While five numbers of the tariff series, with 115 pages, were issued in 1912, only four, containing 113 pages, were prepared for publication in 1915.

The number of items in the statistics of imports and exports has been increased from 1,130 in 1912 to 1,821 in 1916, notwithstanding a decrease in the number of employees in the division of statistics from 39 in 1912 to 30 in 1916.

The volume of mail handled in the Bureau, including both incoming and outgoing mail, has increased from approximately 150,000

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pieces in 1912 to 340,000 (estimated) in 1916. Aside from technical letters, which are prepared in the appropriate divisions, the bulk of the correspondence is handled in the correspondence section. That section alone wrote 48,000 typewritten letters and 40,000 form letters and cards in 1915. While the correspondence doubled from 1912 to 1915, the number of statutory positions in the correspondence section increased only from 9 to 11. An increase in the staff of this section is imperative if we are to maintain a prompt and satisfactory service for American manufacturers.

To summarize: In the face of a decrease of 6 men in the office staff provided by statute, from 1912 to 1916, the publications of the Bureau handled by the editorial division have increased, in number of pages, 70 per cent; the number of trade opportunities published has more than doubled; five times as many confidential circulars are being issued, and six times as many foreign tariff statements prepared; the correspondence has doubled; and the detail shown in statistical tabulations has been increased 40 per cent.

EXTENSION OF COMMERCIAL ATTACHÉ SERVICE.

There is no doubt, from the actual accomplishments in the field, and from the letters of commendation which have been received from American business concerns, that the commercial attaché service should be considerably extended, and if ever the extension of the attaché service will benefit American business, now is that time. There are certain parts of our foreign markets which are at present entirely untouched by our commercial attaché service, and there are certain other parts of the world which are combined with other territories in such way as to give a rather inadequate service.

The great sections of the world in which we are not represented by commercial attachés are Italy, Turkey, Africa, India, Austria-Hungary, Mexico, Central America, and sections of the Near East, and some of these are the very best markets that the United States can hope to obtain. There are other countries that are inadequately provided for. Belgium, Spain, Portugal, and Switzerland, for example, are under the jurisdiction of the commercial attaché stationed in Paris, while the Netherlands, Denmark, Norway, and Sweden are under the charge of the attaché in Berlin. At least Spain and the Scandinavian countries should have separate and independent attachés. The same is true of Japan, which is under the direction of the attaché at Peking. Accordingly, it is recommended that 10 additional attachés be appointed and stationed in the Netherlands, Scandinavia, Italy, Spain, the Balkan States, Central America, Venezuela and Colombia, Japan, India, and South Africa.

EXTENSION OF FIELD SERVICE.

One of the most useful branches of the Bureau's work is that of commercial agents. These agents, who are experts in special industries, have been sent out from time to time to make special investigations and their reports, which relate to specific lines of trade, have been of the greatest value to the American manufacturers who are interested in building up their foreign markets. The great difficulty,

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however, which is found in connection with this work is that it is impossible for the Bureau to send out a sufficient number of these men to make the studies in any one industry with the completeness and adequacy which is desirable.

Herewith is presented a statement (Table 7) of the activities of the commercial agents during the last few years and showing exactly when and where certain lines of industry have been investigated. This statement shows clearly that certain lines of industry have received scant attention. For example, such important investigations as linen, jute, and hemp in 1914, electrical instruments in 1912, chemicals in 1911, and iron and steel in 1909 were restricted to Europe; proprietary medicines were investigated in Latin America only; and there are a number of other lines of industry which have not received adequate attention. It will also be observed that the Canadian market has been investigated only once, for cotton goods; that the African market has been investigated only twice, for cotton goods and for shoes and leather goods. These facts reveal serious inadequacies in the work to date, and it is proposed to push this work vigorously in the future and to extend it to many parts of the world which have not heretofore been thoroughly investigated.

TABLE 7.—INVESTIGATIONS OF FOREIGN MARKETS FOR AMERICAN PRODUCTS, MADE AND PROPOSED, BY SPECIAL AGENTS OF THE BUREAU OF FOREIGN AND DOMESTIC COMMERCE.

[Date shows fiscal year in which investigation was made or is to be made.]

Investigation.	Agent.	Europe.	Near East.	Far East.	Africa.	Latin America.	Australia.	Canada.	United States.
Agricultural implements.	Dennis	1908	1908	1909					
	Von Motz					[a] 1916			
	Homs				[b] 1916		[b] 1916		
Alcohol, denatured	Crampton	[c] 1914							
Canned goods	Shriver	[d] 1914		1913					
	Thayer					1913			
Carriages and wagons									
Chemicals	Norton	[e] 1911							1915
Coal and coke									
Confectionery									
Cotton goods	Crist			1905					
	Burrill			1905					
	Whittam	[f] 1907							
	Clark	1908	1908	1906		1910–11		1913	
	Odell	1912	1912	1915–16	1913		1917		
	Hause	[f] 1912							
Electrical apparatus									
Electrical instruments and meters.	Brooks	1912							
Electrical power development.									
Flour	Davis	1908	1909						
	Turner					1911			
Fruits and nuts	Fischer					1916			
Furniture						[g] 1916			
Glass and glassware									
Hardware	Brill					1915			
	Commercial attachés.	[h] 1915	[h] 1915	[h] 1915		[h] 1915	[h] 1915		
Iron and steel	Pepper	1909							
Jewelry									

[a] Agent will sail about Oct. 1, 1915.
[b] Agent will sail about Oct. 1, 1915, and will cover South Africa and reach Australia in 1916.
[c] Compilation.
[d] Southern.
[e] American consul at Chemnitz, Germany, on detail to Department of Commerce as commercial agent.
[f] England only.
[g] Man to make investigation is being sought.
[h] An exhaustive study of the markets for American hardware was made by the commercial attachés in their respective districts.

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TABLE 7.—INVESTIGATIONS OF FOREIGN MARKETS FOR AMERICAN PRODUCTS, ETC.—Continued.

Investigation.	Agent.	Europe.	Near East.	Far East	Africa.	Latin America.	Australia.	Canada.	United States.
Linen, jute, and hemp	Clark	[a] 1914							
Liquors (vinous, malt, and distilled).									
Lumber	Simmons					1915–16			
	Smith			1915–16					
	Benson								1915
Machinery, general	Alexander			1912–13			1913		
	Carden	1909–10							
	Massel					1916			
Machine tools	Carden	1909–10							
	Alexander			1911–12					
	Massel					1915			
Medicines, proprietary	Thayer					1913			
Motor vehicles									
Oil-seed products	Brode	1910	1910						
	Thompson	1914							
Pottery	Pepper	[a] 1906							
Paints and varnishes									
Paper and wood pulp									
Railway supplies and equipment.				1917	1917		1917		
Shoes and leather goods	Butman	1907,13	1912		1913	1908–10			
				1917			1917		
Structural materials									
Surgical instruments and supplies.	Thayer					1913			
Wearing apparel (men's, women's, and children's).	Sams	1917		[b] 1916			1917		
						[c] 1916			
Woolen goods	Clark	[a] 1908							

GENERAL ECONOMIC INVESTIGATIONS.

Banking and credits	Wolfe	1912							
	Hurley					1914			
	Lough					1915			
Commercial laws	Wolfe	1913							
	Borchard					1916			
Commercial organizations	Wolfe	1913							
	Brand								[d] 1912
	Doonan								[e] 1913
Investment possibilities						1917			
Packing for export									1917
Tariff systems	Rutter					1912			
Transportation rates	Sheridan					[f] 1912			
Water terminals	Jones								1915

[a] United Kingdom only.
[b] Agent will sail about Oct. 1, 1915.
[c] Man to make investigation is being sought.
[d] East and Middle West.
[e] South and Pacific coast.
[f] Work done in United States.

The work of commercial agents and special agents during the last fiscal year is described in detail elsewhere in this report.

It is hoped that provision will be made by Congress for the establishment of a division of field agents in the Washington office. At present the commercial agents are under the general direction of the Latin-American division. This was an arrangement made solely for purposes of convenience and it has resulted not only in the overworking of that division but also in inadequate supervision of the field agents.

Instead of confining field investigations, as in the past, almost exclusively to foreign countries, it has been decided to devote a portion of the fund for promoting commerce to the pursuit of pertinent lines of inquiry in the United States. The first investigation of this kind was begun during the fiscal year, when Commercial Agent Grosvenor M. Jones was assigned to a study of ports and port

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facilities in this country. This inquiry includes a study of the location and physical characteristics of 68 leading ports, extent and ownership of water front, terminal facilities and handling equipment, wharf construction, port administration, port charges, and other related subjects. The necessary field work had been completed and the manuscript of the report was being prepared at the close of the fiscal year.

INTERNAL COMMERCE.

Another part of the proposed reorganization is the establishment of a division of internal commerce.

Until June, 1912, and for many years preceding, the Federal Government collected and published monthly statistics of internal commerce in the United States. These statistics consisted of domestic commercial movements on rivers, canals, and the Great Lakes; the coastwise commerce of some Atlantic and Gulf ports; and the receipts and shipments of important commodities at the principal commercial centers of the country.

This valuable service was discontinued in 1912, and while many protests were made at the time by business men, publishers, and others, the service has not been restored because Congress failed to make the necessary appropriations. There is, at present, no official or private publication which shows these domestic commercial movements. The abolition of this work has destroyed the only means of collecting, recording, and publishing this information, which constitutes the most effective index, from month to month, to the condition of the domestic commerce of our country. This information is of vital importance, not only for current business use but also as a historical record of our country.

By means of the statistics of river, canal, and Lake commerce, it was possible to trace the movements of certain commodities and furnish useful data to engineers and harbor authorities.

There never were any satisfactory data concerning coastwise commerce, because there is no law requiring such information to be supplied. In view of the increase in such commerce during recent years, the opening of the Panama Canal, and the agitation of an inland waterway along the Atlantic coast, it is especially important that accurate statistics should be obtained each month of the coastwise movements of vessels and commodities.

The various industrial centers of the country find it important to keep posted concerning the quantity and value of leading commodities passing in and out and to compare the same with similar movements in other cities. Such information is being privately compiled in a large number of cities, but as each city has its own method of presenting the statistics and as there is no way at present of collating and publishing this information collectively, its chief value is lost.

In the collection of this information prior to July, 1912, the Department had the cooperation of the Federal and State officials, port authorities, secretaries of commercial organizations, transportation companies, and private individuals, aggregating about 500 correspondents, none of whom received any special compensation for this service, yet who, on account of their interest in the work, were regularly supplying this information monthly to the Department.

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On account of this cooperation, it was possible to maintain this service at a comparatively small cost.

An appropriation of about $50,000 would enable the Department to restore this service on an official basis. With such an annual appropriation, the Federal Government could establish and maintain a system of internal commerce statistics which would equal that of any country in the world.

VI.

NEED OF ENLARGED APPROPRIATIONS.

The proposed reorganization of the Bureau's work and the extension of its service so that it will be more useful to the manufacturers and exporters of the United States will, of course, involve a considerably larger expenditure than heretofore. The exact amounts which will be needed for these various purposes have been determined upon and the exact manner in which the appropriations desired are to be expended is outlined in comparison with the years 1916 and 1915 in Table 8. This table is drawn up according to the plan of organization presented on the organization charts.[a] It shows that an appropriation of $935,360 is asked for the fiscal year 1917, and that this is an increase of $516,080 over the year 1916. It will be observed, however, that this especially affects the foreign service of the Bureau and that the increase proposed in the Washington office is a comparatively small one and that only very small increases are asked for, except in the actual trade-promoting parts of the Bureau's work.

TABLE 8.—APPROPRIATIONS FOR THE BUREAU OF FOREIGN AND DOMESTIC COMMERCE DURING THE FISCAL YEARS ENDING JUNE 30, 1915 AND 1916, AND ESTIMATES FOR THE FISCAL YEAR ENDING JUNE 30, 1917.

	1915		1916		1917	
	Employees.	Amount.	Employees.	Amount.	Employees.	Amount.
Statutory appropriation:						
Administration	5	$16,350	5	$16,350	8	$21,600
Compiling statistics	30	41,250	30	41,250	31	43,600
Editorial work	12	16,900	14	18,800	14	21,400
Collating tariffs	6	9,000	6	9,000	9	14,700
Distributing information	5	5,600	5	5,600	6	7,850
Research and translation	3	5,000	3	5,000	7	12,250
Correspondence section	10	11,300	10	11,500	14	16,450
Fiscal accounts, etc	18	16,780	13	11,780	22	22,510
Total	89	122,180	86	119,280	111	160,360
Promoting commerce:						
Office staff	2	3,600	2	3,600	10	15,600
Field investigations	[b] 12	26,450	[b] 8	28,400	20	149,000
Collection of samples	.....	.....	.....	.....	4	19,000
Distributing American literature abroad	.....	.....	.....	.....	.....	10,000
Miscellaneous	.....	7,050	.....	4,800	.....	10,400
Maintenance of district offices—						
Salaries in district offices—						
Atlanta	2	4,200	2	4,400	1	1,400
Boston	2	2,800	2	3,200	2	4,200
Chicago	2	3,200	3	3,800	4	5,600
New Orleans	2	3,400	2	2,990	2	3,150
New York	6	8,800	6	7,900	11	13,120
San Francisco	2	3,000	2	3,200	2	3,250
Seattle	2	2,700	2	3,000	2	3,000
St. Louis	2	3,300	2	3,300	2	3,450
Miscellaneous, including rent, traveling expenses, supplies, cablegrams, temporary clerical assistance, etc	.....	6,500	.....	6,500	.....	8,830
Total	34	75,000	31	75,000	60	250,000

[a] Charts not printed in this compilation. [b] Including employees serving less than a year.

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TABLE 8.—APPROPRIATIONS FOR THE BUREAU OF FOREIGN AND DOMESTIC COMMERCE DURING THE FISCAL YEARS ENDING JUNE 30, 1915 AND 1916, ETC.—Con.

	1915		1916		1917	
	Employees.	Amount.	Employees.	Amount.	Employees.	Amount.
Commercial attachés:						
Office staff					6	$9,400
Salaries, commercial attaches, clerks, and expenses—						
Balkan States					2	10,500
France (Paris)	2	$10,000	2	$10,000	2	11,000
Germany (Berlin)	2	10,000	2	10,000	2	11,000
Italy					2	11,000
Netherlands					2	10,500
Russia (Petrograd)	2	10,000	2	10,000	2	11,000
Scandinavia					2	10,500
Spain					2	11,000
United Kingdom (London)	2	10,000	2	10,000	2	11,000
Central America					2	10,500
Argentina (Buenos Aires)	2	10,000	2	10,000	2	11,000
Brazil (Rio de Janeiro)	2	10,000	2	13,000	2	11,000
Chile (Santiago)	2	10,000	2	10,000	2	10,500
Peru (Lima)	2	10,000	2	10,000	2	10,500
Venezuela and Colombia					2	10,500
China (Peking)	2	10,000	2	10,000	2	11,000
India					2	10,500
Japan					2	11,000
Australia (Melbourne)	2	10,000	2	10,000	2	11,000
South Africa					2	10,600
Total	20	100,000	20	100,000	46	225,000
Cost of production:						
Office staff	8	9,800	8	10,500	11	15,900
Field investigations	10	38,600	10	35,500	14	76,000
Miscellaneous, including supplies		1,600		4,000		8,100
Total	18	50,000	18	50,000	25	100,000
Internal commerce:						
Office staff					13	15,560
Local statistical experts					8	13,000
Field agents and correspondents					32	19,000
Miscellaneous, including travel and subsistence, supplies, etc						2,440
Total					53	50,000
Latin America:						
Office staff	8	11,800	12	15,200	14	20,000
Field investigations	[a] 9	31,900	[a] 15	51,800	16	68,250
Miscellaneous		6,300		8,000		11,750
Total	17	50,000	27	75,000	30	100,000
Agricultural investigations					7	50,000
Grand total	178	397,180	182	419,280	332	935,360

[a] Including employees serving less than a year.

The matter of appropriations will be treated under the various important headings shown on Table 8.

STATUTORY APPROPRIATION.

It is in the statutory appropriation, which is expended in the Washington office, where the greatest need for additional help exists. As has already been pointed out, the work of the Bureau has steadily increased, the field staff has increased eightfold, while the statutory staff in Washington has remained stationary, the actual appropriation having decreased from $122,180 in the fiscal year 1915 to $119,280

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in the fiscal year 1916. If the most effective work is to be done, a number of high-grade employees are needed in the Bureau. This is because the work of the Bureau of Foreign and Domestic Commerce is in no sense routine work. It is of a varied character and demands initiative at every point. Great funds of information come into the Bureau and if we have no men capable to take this information and put it into practical use and to assist in bringing about practical results, much of it disappears and is lost. We especially need a man to take charge of the commercial attaché service; another to take charge of the commercial agent service; a third to take charge of the branch office service. All of these men should be chiefs of division and comparatively well paid, not less than $2,500 per annum. We also need experts on special subjects, such as tariffs and financing as it relates to foreign trade, and expert investigators to whom problems of special importance, as they come up from time to time, can be referred.

The Bureau is also badly in need of stenographers and typists to keep up with the great bulk of correspondence which is coming in.

FUND FOR PROMOTING COMMERCE.

The work under the fund for "Promoting commerce" falls naturally into two divisions, (1) the commercial agent service, (2) the branch office service.

First, the commercial agent service is a most important feature of our trade-promoting organization. Up to the present time, however, the markets for only a few industries and in only one or two sections of the world have been investigated. Reference to Table 7 on page 272 will show that our studies have not covered the entire world, even in the principal industries, and that there are many industries which have, so far, remained entirely unstudied. We propose to make as many of these special investigations as possible under the appropriation which Congress will give us for the fiscal year 1917. Such investigations will include markets for cotton textiles, packing, motor vehicles, railway supplies, leather boots and shoes, agricultural implements, furniture, machinery, electric-power development, structural material, wearing apparel, and investment possibilities, in as many sections of the world as possible.

Second, the branch offices have done most effective work. They have been maintained out of the general fund for "Promoting commerce" and no special increase is asked for this department of our work. The collection of samples, however, is an important feature of our work in promoting commerce and can be made of much greater use to the business public. We are asking, therefore, for a sufficient appropriation to enable us to establish a collection of samples in New York and to arrange to send these samples throughout the United States for exhibition at our various branch offices and at chambers of commerce and other trade organizations.

COMMERCIAL ATTACHÉ FUND.

The commercial attaché service is an accomplished fact. Ten men are now in the field and during the past year have done excellent work. They cover about one-half of the important sections of the

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world. We need 10 more commercial attachés in such important countries as Japan, India, South Africa, Spain, Scandinavia, Italy, the Netherlands, the Balkan States, Central America, Venezuela, and Colombia. This organization will then effectually cover the entire world and our equipment in this particular branch of work will equal that of any other country.

COST OF PRODUCTION FUND.

The work carried on under the "Cost of production" fund has been limited by a very inadequate appropriation, which has not enabled us to make any large number of investigations or to publish a large number of reports. There are several important industries which should have our attention at this time. The demands for expert and scientifically collected data on the comparative costs of production in this country and abroad are so great that we feel justified in requesting an additional appropriation to carry on this work effectively during the coming year.

INTERNAL COMMERCE.

The need of the collection of statistics with reference to the internal commerce has been emphasized on pages 274 and 275. It is proposed to create a new division to take care of this work, and to attach statistical experts to each of our branch offices for the purpose of securing data and overseeing the collection of statistics at other points by correspondents, for whom slight compensation is provided. A staff of compilers and statisticians at Washington is provided for. This small staff will make it possible to furnish information which is constantly in demand with reference to statistics of internal commerce.

FUND FOR PROMOTING COMMERCE IN SOUTH AND CENTRAL AMERICA.

Inquiries for information about Latin America have poured into this office from every part of the United States. The necessity for building up our relations with Latin America and for informing American business men as to the exact conditions there is obvious. It is planned to continue the work which has already commenced and to amplify the number of field investigations of markets for particular lines of industry in all of Latin America.

FUND FOR AGRICULTURAL INVESTIGATIONS.

This is a new appropriation and it is anticipated will provide for studies of foreign markets for various agricultural and other natural and raw products of the United States. The fund for "Promoting commerce," it is believed, was designed by Congress primarily for the purpose of studying markets for manufactured goods. There has, however, been a constant demand for investigations of foreign markets for lumber, fruit, coal, cotton, wheat, flour, rice, etc. The Bureau feels that such investigations should be made and that it should be the aim of this Bureau to study the markets for these raw materials in foreign countries and to furnish the producer in this country with information which will enable him to market his products more

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profitably and to obtain a larger share of the world's trade. We have provided for no administration at Washington in connection with these investigations, as the work can properly be handled under the division of field agents, which it is proposed to establish under the fund for "Promoting commerce."

VII.

WORK OF THE VARIOUS DIVISIONS.

EDITORIAL DIVISION.

The larger scope of field investigations has entailed a much larger volume of editorial work. This is performed in the editorial division, formerly termed the "division of consular reports," which prepares for publication not only the reports of consular officers but the large number of reports from the Bureau's commercial agents and new force of commercial attachés. The manuscript reports must not only be handled for revision in composition and statistics, but for form and content and to ascertain to what extent they constitute information which should be issued by the Department of Commerce. During the fiscal year ended June 30, 1915, the division turned out the largest volume of work in its history.

COMMERCE REPORTS.

The most notable change during the year was the conversion of the Daily Consular and Trade Reports, which required at best six days for publication, into a real commercial daily, made up only one day in advance, and renamed Commerce Reports. This publication is not only the organ of the entire Department of Commerce, with frequent articles on the activities of the various bureaus, but serves as the Government commercial gazette, publishing all the notices for Government supplies and construction, and actions of other departments which concern the business and industries of the United States. The free circulation of Daily Consular and Trade Reports was discontinued July 1, 1914, except copies for commercial organizations, the press, libraries, and the use of the Government. Announcement was made through extensive circulars that the Superintendent of Documents would receive subscriptions for the "Daily" at $2.50 per annum, to which nearly 1,000 persons immediately responded. This increased by the end of October, 1914, to 2,000. The continued cooperation of the chambers of commerce of the country enabled us to bring the number of subscriptions to 3,100 on December 31, 1914. The wider scope and prompter issuance of Commerce Reports has brought further paid subscriptions at $2.50 each so that on June 30, 1915, the number stood 4,597, together with 225 subscriptions at $6 each for bound quarterly volumes. This results in an income from one Government publication at the rate of $13,842.50 per annum, which, it is learned, is a larger sum than is received from any other Government periodical. It is expected that the subscriptions for Commerce Reports during the coming fiscal year will be further increased. In view of the fact that people are accustomed to free distribution of official publications, it is considered that splendid progress has been made in putting this service on a subscription basis.

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PREPARATION AND PUBLICATION OF ANNUAL CONSULAR REPORTS.

Beginning with January 1, 1915, the annual reports submitted by the consular officers have been published as supplements to Commerce Reports. During the first six months 74 supplements were issued, totaling 1,082 pages. That the business public is alive to the value of these annual reports is indicated by the large number of inquiries concerning them. They form a valuable reference compendium and a record for consultation for those wishing to sell their goods in every country of the world.

MONOGRAPHS.

The monograph work of the editorial division during the fiscal year 1914–15 comprised the following:[a]

Special agents series.—No. 86. Cotton Goods in Manchuria and Japan, by W. A. Graham Clark; 282 pages. Price 30 cents.

No. 87. Canned Goods in South America, by E. A. Thayer; 36 pages. Price 5 cents.

No. 88. Lumbering Industry of the Philippines, by John R. Arnold; 23 pages. Price 5 cents.

No. 89. Cottonseed Products and Their Competitors in Northern Europe, Part 2, Edible Oils, by Erwin W. Thompson; 31 pages. Price 5 cents.

No. 90. Banking and Credit in Argentina, Brazil, Chile, and Peru, by Edward N. Hurley; 72 pages. Price 10 cents.

No. 91. Canned Pineapple Industry of the World, by J. Alexis Shriver; 43 pages. Price 5 cents.

No. 92. Canned Goods in the Far East, by J. Alexis Shriver; 78 pages. Price 10 cents.

No. 93. Canned Tomato Industry in Italy, by J. Alexis Shriver; 23 pages. Price 5 cents.

No. 94. Japanese Markets for American Lumber, by Franklin H. Smith; 16 pages. Price 5 cents.

No. 95. Rattan Supply of the Philippines, by John R. Arnold; 40 pages. Price 5 cents.

No. 96. Dyestuffs for American Textile and Other Industries, by Thomas H. Norton; 57 pages. Price 10 cents.

No. 97. Commercial Laws of England, Scotland, Germany, and France, by Archibald J. Wolfe and Edwin M. Borchard; 130 pages. Price, 15 cents.

No. 98. Commercial Organizations in France, by Archibald J. Wolfe; 75 pages. Price 10 cents.

No. 99. Cottonseed Industry in Foreign Countries, by Thomas H. Norton; 73 pages. Price 10 cents.

No. 100. Philippine Market for American Lumber, by Franklin H. Smith; 16 pages. Price 5 cents.

Special consular reports.—No. 66. South American Market for Soap; 16 pages. Price 5 cents.

No. 67. Cooking Fats in South America; 16 pages. Price 5 cents.

No. 68. Tobacco Trade of the World; 48 pages. Price 5 cents. (This was mostly written in the division of consular reports.)

No. 69. Foreign Markets for Coal; 24 pages. Price 5 cents.

No. 70. South American Markets for Jewelry and Silverware; 24 pages. Price 5 cents.

No. 71. Some Aspects of the Iron and Steel Industry in Europe; 48 pages. Price 5 cents.

No. 72. Handbook of India, 640 pages, with maps, illustrations, etc. Price $1.

No. 73. Paper and Stationery Trade of the World; 450 pages. Price 50 cents.

Miscellaneous series.—No. 16. Cost of Production in the Pottery Trade; 43 pages. Price 10 cents.

No. 17. Publications on Latin America and the West Indies (a syllabus of all our monographs covering those regions); 15 pages. Price 5 cents.

[a] For statistical publications, see pp. 284–285; foreign tariff publications, p. 288.

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No. 18. Statements on Latin American Trade Situation; 39 pages. Price 5 cents.
No. 21. The Pottery Industry; 709 pages. Price 50 cents.
No. 24. Industrial Conditions of Montgomery County, Pa.; 16 pages. Price 5 cents.
No. 25. European Markets for Fish (compiled entirely by the research section and consular division); 36 pages. Price 5 cents.

HANDBOOKS OF FOREIGN COUNTRIES.

An exhaustive study was made during the year of the commerce of India, to whose 320,000,000 people we sell less than to Denmark, which has 2,500,000 people. Mr. Henry D. Baker, now our commercial attaché at Petrograd, formerly in the Consular Service, was sent to India for this special investigation, and traveled throughout the Empire. The material gathered through his travels and through research in Washington enabled us to bring out an exhaustive handbook on India containing 640 pages, with maps and illustrations, which the Superintendent of Documents sells at $1 per copy. This valuable information should greatly increase American trade in British India. The series of commercial handbooks on foreign countries is to be continued, one on Central America being now in course of preparation and will be published during the coming year. It is hoped later to undertake handbooks on China and other countries where American commerce might be greatly developed.

CATALOGUE OF PUBLICATIONS.

The publications issued by the Bureau in the 10 years of its existence have multiplied into a library covering a wide range of useful commercial, industrial, and economic knowledge. These monographs are for sale by the Superintendent of Documents, but no catalogue exists for exploiting them properly among the people. A comprehensive syllabus is, therefore, being prepared which will be issued as a catalogue so that business men may readily find what will be of interest and thus promote a larger use of the Bureau's publications.

A summary of the publications, exclusive of statistical and tariff reports, for the past three years is given in Table 9:

TABLE 9.—PUBLICATIONS HANDLED IN THE EDITORIAL DIVISION DURING THE FISCAL YEARS ENDED JUNE 30, 1913–1915.

Publication.	1913		1914		1915	
	Number.	Pages.	Number.	Pages.	Number.	Pages.
Daily Commerce Reports	306	6,528	306	6,512	306	5,904
Index to Commerce Reports	4	137	4	134	4	156
Supplement to Commerce Reports					74	1,082
Special consular series	7	712	6	675	8	1,266
Commercial agents series	15	1,232	14	2,277	15	930
Confidential bulletins	2	18	8	63	12	115
Miscellaneous series	2	252	3	467	6	995
Total	336	8,879	341	10,128	425	10,448

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TRADE OPPORTUNITIES.

Foreign trade opportunities calling attention to direct openings for the sale of American goods were prepared by the division during the year to the number of 4,090. The number prepared in previous years was as follows: In 1906, 198; in 1907, 960; in 1908, 1,227; in 1909, 1,180; in 1910, 1,592; in 1911, 1,796; in 1912, 2,145; in 1913, 2,162; and in 1914, 2,088. It will thus be seen that the direct trade inquiries received at the Bureau from abroad last year almost equaled the record for the two previous years combined. The extra amount of work involved, with no additional clerical assistance, necessitated many hours overtime work by the employees. It is gratifying that these trade opportunities resulted in the sale of many million dollars' worth of American products. The Bureau does not learn the results of each of these, but testimony of their effectiveness comes in daily. A record of the results in many cases appears in Commerce Reports, but mention can be made of only a few of these direct results.

TRADE DIRECTORY WORK.

The revision of the World Trade Directory is continued for large geographical sections of the globe. The South American Trade Directory was issued in 1913–14, and 5,784 copies have been sold to date by the Superintendent of Documents at $1 per copy. The revised trade directory for Central America and the West Indies was prepared during 1914–15 and sent to press. Its delivery ready for sale is expected early in the new fiscal year. The trade directory revision for British India and the East Indies may later be undertaken. The preparation of these lists of foreign merchants entails a great amount of close investigation and research by the American consuls and also further careful preparation in checking up at the Bureau of Foreign and Domestic Commerce.

A most promising field of usefulness in foreign trade promotion is the amplification of the World Trade Directory work. The Bureau has made steady progress since this was instituted by the division of consular reports about seven years ago, and the selected lists of foreign importers are greatly appreciated by American exporters. It is desired to undertake the compilation of more information about these individual foreign buyers, especially as to the extent of their business and as to their attitude toward American merchandise. This would not involve the financial rating of business houses abroad, but would include valuable reference material which would afford great help especially to those considering entering foreign markets.

CONFIDENTIAL CIRCULAR WORK.

Very practical means of helping the American manufacturer to enter the export trade were presented in the 505 confidential circulars issued during the year. The growth of this service is remarkable, as only 137 were issued in the previous fiscal year and 97 in 1913. This method conveys the details of the prospective buyers' needs, and enables the American exporter to quote directly without further correspondence. A few illustrations of the good of this work may be of interest.

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Confidential Circular No. 249, of August 4, 1914, gave details of an arrangement with the French Import Agency Association with its 7,000 members to help American exporters.

The telegram from Santos issued as Circular No. 291, of September 10, 1914, brought about the shipment of cargoes of potatoes to Brazil.

The United States has been supplying less than 2 per cent of the twenty million dollar flour trade of the Mediterranean regions, but through our trade-promotion efforts and confidential circulars there were sold to the eastern Mediterranean during the year entire shiploads of flour, one St. Louis firm alone advising the Bureau that our assistance had enabled it to sell $800,000 worth of flour in Greece within a few months.

Many inquiries for American coal were issued, coming from practically every country in South America, from Scandinavia, from Italy, Spain, and Egypt, from the Canaries, and numerous other places. This stirred up immense interest in the export coal trade, especially in view of the fact that the coal producers claimed that the home market is congested, and that the domestic business is overdone. This foreign trade stimulation has brought representatives of coal operators and of railroad companies to visit the Bureau's offices in large numbers, and they were supplied with information which they stated could not be had elsewhere. As a consequence of this trade activity, cargoes of American coal aggregating many million dollars went to foreign countries which had never before used coal from the United States.

Other inquiries furnished to American manufacturers included a request from the Portuguese Government for prices on aeroplanes, grain elevator equipment for the Russian Government, telephones for the Greek Government, a $600,000 cotton-mill equipment for Hankow, China, post-office equipment for the Honduran Government, the opening of an American store at Teheran, Persia, motor sleighs for Finland, auto motors for Chilean interurban railways, also electric railway equipment for Chile, paper for the Argentine Government, etc.

GENERAL PUBLICATION NOTES.

Miscellaneous circulars prepared and issued by the division during the year numbered 24.

Proposals for Government supplies and construction prepared during the year numbered 613, compared with 530 in the 1913–14 year. This service is helping the various departments of the Government to obtain many more bids on its enormous purchases, while all manufacturers are also thus enabled to keep posted on the Government requirements.

The monthly publication, Sailing Dates of Steamships from Ports of the United States to Foreign Countries, was discontinued with the issue of December, 1914. The number of people interested in this was small and it duplicated work of other organizations.

DIVISION OF STATISTICS.

Every effort has been made to meet the unprecedented increase in the demands on the statistical division for information, but, owing to the limited force engaged on the statistical work, it has not been

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possible in all cases to extend the statistical tables in the Monthly Summary sufficiently to provide current information regarding the many changes in trade with European countries.

In order to keep in close touch with conditions, weekly telegraphic reports of total values of imports, exports, and duties collected during the preceding week have been required since October 1 from collectors of customs at the 13 principal ports. This information has been distributed by means of press bulletins issued every Tuesday morning. Similar weekly reports have also been received and issued for the exports of cotton and the imports and exports of copper.

These statements filled a real demand during the first year of the war, when the business public was specially apprehensive and uncertain about foreign trade conditions. It is known that the weekly figures are to a considerable extent unreliable and do not correspond with the final monthly figures. Moreover, the various customhouses are not equipped to carry on this extra work, without delaying the regular monthly reports and thus retarding the issue of publications. Since commercial and industrial conditions have improved and the general situation has become more settled, it is believed that the weekly statements may soon be discontinued.

To meet the demand for information in regard to foreign shipping, a statement has been published in the Monthly Summary since January 1915, showing the tonnage of American and foreign vessels entered and cleared in the trade with each foreign country during the current month and year compared with the same period a year before.

On account of the special interest in statistics of trade with Latin America, the tables of imports from and exports to countries of North and South America in the publication issued for 1913, as Miscellaneous Series No. 15, "Trade of the United States with the World," were greatly extended in classification of articles and brought up to date for 1914. The report was issued as Miscellaneous Series No. 23, "Trade of the United States with Other American Countries," and that it filled a demand was evinced by the fact that within a few months nearly 600 copies were sold by the Superintendent of Documents.

It was contemplated to bring all of the tables in the "Trade of the United States with the World" during 1913 up to date for 1915 and extend materially the classification of articles. It was expected to complete the advance work for the 1914 figures this summer so as to be ready to send copy to press as soon as the data for 1915 became available. On account of the additional work caused by the rush of inquiries on account of the war, it has not been possible to complete this advance work and publication will be delayed until the annual report of Commerce and Navigation is completed.

The provision of Section III, paragraph F, of the tariff law of 1913, placed upon American consular officers in foreign countries the duty to require that the description of goods in invoices presented for certification be in sufficient detail to enable importers to classify the goods in their entry presented at customhouses in accordance with the classification of Schedule E of this Department. This requirement caused at first many protests from foreign shippers and commission houses, especially from England and France. No complaints on this point have been received during the past six months,

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and it may, therefore, be assumed that foreign shippers have become reconciled to the requirement.

Owing to instructions issued by the Treasury Department to collectors of customs to waive a strict compliance with this provision in entries until November 1, 1914, it was not possible to show in the published statistical statements of imports all of the subdivisions required by Schedule E. No serious difficulties in this respect are anticipated during the present fiscal year.

New editions of the statistical Schedules A, B, and E, governing the classification of import and export statements were issued, effective July 1, 1915, but no extensive additions to the former classifications were made at this time for the reason that neither this Bureau nor collectors of customs have been supplied with an increase in the clerical force which would be required to handle an enlarged classification. If the mechanical tabulation proves a success, it is intended to increase the classification materially next year.

Several requests have been received for statements showing the production of articles of domestic manufacture compared with imports and exports of the same articles. Inasmuch as the latest figures of production available relate to the calendar year 1909, it was thought best to defer the preparation of such a statement until the completion of the census of manufactures for 1914, which is now being completed by the Bureau of the Census.

A concerted effort was made last year to expedite the 1914 issues of the annual statistical publications, Commerce and Navigation of the United States and Statistical Abstract of the United States. The former was ready for distribution on April 5 and the latter May 7, fully two months earlier than in any previous year. That these publications are eagerly looked for by the commercial public seems to be demonstrated by the fact that the Bureau was highly complimented on this record.

In order to obtain prompter publication of the Monthly Summary of Foreign Commerce of the United States, an arrangement was reached with the Public Printer through the Division of Publications to make composition of this publication special. The issue of the "Advance Sheets" was discontinued, and the Printing Office agreed to deliver the work in eight working days from the time copy was received. For a time this resulted in prompter publication, but in recent months it has not been possible for the Bureau to forward copy for the monthly publications as promptly as formerly, due almost entirely to retarded statistical reports from the port of New York. This delay was explained to be due to the unprecedented increase in exports on account of the European war. During recent months the work at the customhouses has been increased by the daily reports which are made to New York for mechanical tabulation. This, for the time that the regular monthly reports to this office are continued, duplicates the statistical work and has contributed to the delay of issuing the monthly publications. It is probable that the delay will continue until the system of mechanical tabulation is perfected and the reports from collectors to this office can be discontinued.

The revision of the chapter of the Customs Regulations of 1908 which contains the instructions to collectors of customs with respect

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to the statistical work of this Bureau has been completed and the new regulations soon to be issued will conform to the latest practice in collecting and compiling statistics of imports and exports.

The efforts of the Bureau to collect statistics of shipments of merchandise between the Atlantic, Gulf, and Pacific coasts of the United States through the Panama Canal showing description, quantities, and values of the goods have not been entirely successful. While steamship companies have endeavored to show on the vessel manifest for each shipment the details desired, they are in many cases not in possession of this information and unable to obtain detailed description, and especially values. Consignments are received by them on through bills of lading, values not stated and original shippers unknown. Many shippers object or refuse to state value of goods consigned to steamship companies, since they are not asked to furnish such information if transported on railroad. On the whole, it is known that the statistics obtained and published are far from complete, particularly in regard to shipments from the Atlantic to the Pacific coast, which consist largely of general merchandise.

A letter was addressed to the governor of the Panama Canal suggesting that he might be in a better position to obtain detailed description of the cargo carried by vessels passing through the canal. In reply it was stated that it had been decided to follow the practice of the Suez Canal, where vessels are required to file only a general description of the cargo, segregating the most important items, and that a condensed statement would be published in the Canal Record showing tonnage of principal commodities moving through the canal in the domestic and foreign trade.

In view of these conditions and the infrequent inquiries regarding values, it was decided to limit the statistics of domestic shipments through the Panama Canal to a statement of quantities for the principal articles. The steamship companies engaged in this traffic were unanimous in favoring this plan, stating that if the classification were limited to principal commodities, accurate weights for each of these principal articles would be obtained, also the aggregate weight of the other miscellaneous items combined into one group of "all other articles." The statistical work required from collectors of customs on this statement would be reduced to a minimum, since the steamship companies offer to furnish on the outward-vessel manifest a complete recapitulation of the cargo arranged according to the classification decided upon, provided clearance will be granted on such a manifest. This question has been taken up with principal collectors of customs and the Bureau of Navigation of this Department, who have agreed to the proposition.

This plan, if successful, would obviate the need of extending the statistical requirements of sections 4197 to 4200 of the Revised Statutes, relating to statistics in the foreign trade, to cover coastwise shipments through the Panama Canal. The Solicitor of this Department has been notified to this effect.

The bill, H. R. 11097, to amend the laws relating to shippers' manifests of merchandise for exportation, and for other purposes, introduced in the last Congress, failed of passage. This bill was prepared for the purpose of enabling collectors of customs to obtain more complete and accurate export statistics by requiring shippers of goods from interior points to seaboard ports for exportation to

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furnish a manifest fully describing such merchandise, with a penalty for failure to do so. The present law under which the statistics of exports by vessel are collected was passed in 1820 (sec. 4200, R. S.) and contains no provision for penalizing the shipper for failure to furnish statistical information, but it does provide that the vessel shall not be granted clearance until shippers' manifests for the whole cargo shall have been filed. Under modern conditions, where a large part of merchandise exported is carried by regular liners, this provision has rarely been enforced by collectors of customs.

A plan has recently been devised in cooperation with the Treasury Department to enforce this law by drafting regulations that clearance will not be granted to a vessel having any goods aboard, for which no shippers' manifests have been filed, unless a bond, conditioned upon the production of such manifests within 15 days after clearance, is executed. The Treasury Department is prepared to enforce this regulation strictly and it is thought that good results will follow.

Until it is seen what the new regulations will accomplish, the enactment of the proposed legislation is deemed inadvisable, in view of the considerable opposition to many of its provisions. Appropriate penalties on the shipper for failure to declare exports, for inaccurate statements, and for insufficient detail in his declarations, if provided by law, would undoubtedly strengthen the statistical service.

An extensive study and investigation into statistical methods at the principal customhouses and in this office was undertaken with a view to devising means to remedy existing defects. The results and conclusions of these investigations are discussed in a separate chapter.

DIVISION OF FOREIGN TARIFFS.

The work of the division of foreign tariffs has been considerably affected and increased during the last fiscal year by the establishment of closer cooperation with the other executive departments and particularly with the Department of State, by the inauguration of the commercial attaché service, and by the establishment of an examination system for the appointment of all the commercial agents and commercial attachés of the Bureau.

At the request of the Office of Foreign Trade Advisers, of the Department of State, the Bureau agreed to take over several lines of work in connection with foreign tariffs that were formerly performed by that office. All the consular trade letters with tariff references are now sent to the division for verification before being transmitted to the inquirers. During the second half of the fiscal year they have been coming in at the rate of about 100 per month. The Bureau has also been requested by the Department of State to prepare memoranda in connection with contemplated negotiations of commercial treaties. Among the most important memoranda prepared by the division for the use of the Department of State during the last fiscal year are those dealing with commercial relations of the United States with Russia, Panama, and Bolivia, the tariff discrimination against cotton bags in Latin-American countries, a number of memoranda in connection with the forthcoming revision of the Brazilian customs tariff, and memoranda and statements for use

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in connection with representations in regard to the customs treatment of canned goods in foreign countries. Mention should also be made of the work of editing a very voluminous report on the economic conditions of foreign countries since the outbreak of the European war, and of statements of rates of duty on tobacco and tobacco manufactures, prepared for the use of the Bureau of Insular Affairs, of the War Department.

The examination system for the appointment of commercial agents and commercial attachés and other members of the staff of the Bureau was inaugurated in the early part of the fiscal year, and much time of the members of the staff of the division of foreign tariffs has been utilized for this purpose. The assistant chief of this division is the chairman of the appointment committee and has given a considerable amount of time to this work.

Owing to the special lines of work assigned to the division and the increase in tariff inquiries resulting from the embargo legislation of the belligerent countries, the division was unable to give as much time to the publication of monographs as might have been desired. The publications prepared by the division during the last fiscal year are as follows: Foreign Tariff Notes Nos. 14–17 (representing about 140 pages of tariff notes published in the Commerce Reports); Tariff Series No. 28B (Supplement to the Customs Tariff of Japan); Tariff Series No. 24 (entirely rewritten and restricted to Latin America and Canada); and Tariff Series No. 31 (Trade-Mark Registration in Latin America). In addition to the above, a reprint of Tariff Series No. 25 (Customs Tariff of France) was issued.

The publication of Tariff Series No. 31 (Trade-Mark Registration in Latin America) marks the inauguration of the Bureau's service in connection with the distribution of information regarding foreign trade-mark and patent laws. An assistant in foreign trade-marks was added to the staff of the division in April, and steps have been taken to complete the Bureau's collection of foreign trade-mark and patent laws. It is hoped that the service of the Bureau in connection with foreign trade-marks and patents will in time become as comprehensive as that now rendered in connection with foreign affairs.

While the Bureau on numerous occasions has called the attention of American manufacturers to the importance of trade-mark registration in the foreign countries to which they intend to send their products, it is found from the correspondence on the subject addressed to the Bureau that many important American trade-marks still remain unregistered in foreign countries. Instances have also come under the observation of the Bureau indicating that American trade-marks have been registered by unauthorized persons in some of the Latin-American countries, so that the rightful owners had to pay considerable sums of money for the right to use their own trade-marks. It is hoped that American manufacturers will take advantage of the trade-marks service of the Bureau and secure protection for their valuable trade-marks in foreign countries.

The foreign tariff inquiries addressed to the Bureau continue to increase and the number of letters written by the division during the last year was about 4,000, showing an increase of over 20 per cent as compared with the preceding fiscal year. Numerous statements of rates of duty in foreign countries were prepared for American

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manufacturers and exporters, and some of the more comprehensive ones have been mimeographed or reproduced in the foreign tariff notes, so as to render them available for general distribution. The following products were covered by the more important statements: Raw cotton, tobacco and tobacco manufactures, harness and saddlery, ready-made clothing, canned goods, refrigerating machinery, fire-arms and ammunition, and bags.

The staff of the division was increased by the addition of one tariff assistant and one assistant in foreign trade-marks.

COST OF PRODUCTION DIVISION.

The cost of production division was engaged upon the following investigations during the fiscal year:

1. Cost of production in the pottery industry.
2. Cost of production in the clothing industry: (*a*) Women's muslin underwear; (*b*) hosiery; (*c*) knit goods; (*d*) men's shirts and collars; (*e*) men's clothing.
3. Cost of production of cotton textile machinery.
4. Cost of production of cane sugar.
5. Special investigations.

The report on the cost of production in the pottery industry was completed and published on March 2, 1915. The data for this report were collected by special agents who visited nearly all the potteries making tableware in the United States, also the leading potteries in England, Germany, and Austria. The outbreak of the war prevented the extension of the investigation to France and other European countries. The report, which covers 706 pages, deals not only with the cost of production but also with factory equipment, efficiency, and other manufacturing and labor conditions as well as the technical aspects of the industry.

Of the clothing investigations above enumerated, the reports on women's muslin underwear, hosiery, and knit goods are in manuscript, but will be printed and available for distribution by the close of the calendar year, while those on men's shirts and collars and men's clothing are in course of preparation, the field work having been completed. In conducting these investigations, special agents visited a sufficient number of establishments in each branch to present a fair picture of the industry as a whole. It had been planned to extend these investigations to European countries, but the outbreak of the war prevented this. These investigations, like that of the pottery industry, were not confined to the cost of production but included also studies of other industrial and labor conditions.

In connection with the clothing investigation, tentative plans had been made for a study of the cost of distribution of articles of clothing, but the Comptroller of the Treasury ruled that such an investigation could not be paid for out of the appropriation for investigating cost of production.

An investigation of the cost of production of cotton textile machinery was begun, and the field work was completed during the fiscal year. This investigation covers conditions during the past nine years. The data were being tabulated and the manuscripts being prepared at the close of the fiscal year.

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The investigation of the cost of production of cane sugar had not passed the preliminary stage and no field work had been done upon it at the close of the fiscal year. It is planned to investigate the cost of production, factory equipment, efficiency, and other conditions on the sugar plantations and in the factories in the Hawaiian Islands, Porto Rico, and Cuba.

Special investigations were made by special agents in some of the leading cities concerning the rise in prices of food commodities in August, 1914, and of the rise in the prices of lead and zinc, in October and November, 1914. The results of these investigations were transmitted to the Department of Justice.

In January, 1914, an investigation on industrial conditions in Montgomery County, Pa., was made by a special agent in response to a complaint made by an association of local manufacturers. The report of this investigation was printed.

In addition to the work of the special agents, considerable work was done by experts in the office in the planning of investigations, the tabulating of data, the revising and editing of reports, research work in connection with the various investigations, and in response to requests and complaints concerning prices and industrial conditions, administrative work, etc.

The following new investigations were recommended for the next fiscal year:

1. Cost of production of wool blankets and carded wool.
2. Cost of production in the glass industry.
3. Cost of production of tin plates.
4. Industrial conditions in the United States.

The last-mentioned subject is to consist of a report, the data of which are to be prepared in this office, showing for all important classes of articles of importation during the present and the three preceding tariff periods, by years, the value of imports, duty paid, the actual tariff rate, and the computed average ad valorem rate; summary tables of statistics of manufactures showing capital invested, persons employed, and value of product for each industry in 1899, 1904, 1909, and 1914, as published by the Census Bureau; statistics of prices and wages, from publications of the Bureau of Labor Statistics, and such other data as may be of interest in connection with the recent development of American industries.

In order that this Bureau may be enabled to investigate and report upon all matters pertaining to the cost of production and distribution, prices, and other industrial conditions, it is recommended that the following language be used in estimates for appropriations for this division, changes in wording being indicated by italics:

Cost of production: For salaries and all other actual and necessary expenses, including field investigations at home and abroad, compensation of experts, special agents, *clerks, and stenographers* to be employed in Washington, District of Columbia, or in the field, rental of quarters outside of the District of Columbia when required, purchase of reference books, manuscripts, and periodicals, to enable the Bureau of Foreign and Domestic Commerce of the Department of Commerce *to investigate the cost of production and the cost of distribution of all articles which have been, or may be made the subject of tariff legislation, with special reference to the prices paid domestic and foreign labor and the prices paid for raw materials, whether domestic or imported, entering into manufactured articles, producers' prices and retail prices of commodities, whether domestic or imported, the cost of transportation from the*

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place or places of production to the principal areas of consumption, the condition of domestic and foreign markets affecting the American products, including detailed information with respect thereto, together with all other facts which may be necessary in fixing import duties or in aiding the President and other officers of the Government in the administration of the custom laws, $100,000.

SUPERVISION OF COMMERCIAL ATTACHÉ SERVICE.

The appropriation act establishing the commercial attaché service did not provide for the administrative work connected with the service in Washington, and it was therefore necessary to assign these duties to an assistant chief of division and clerks heretofore performing other work. Effective results can be obtained only by placing the administration of the service in the hands of a competent chief and by providing him with adequate clerical assistance.

The establishment of a permanent foreign service presented many new problems to the Bureau, as existing regulations were framed to govern the activities of the Bureau in the United States and the employment of special investigators temporarily stationed in foreign fields. On many questions it was necessary to obtain the opinion of the Solicitor of the Department and the decision of the Comptroller of the Treasury. This situation resulted in a large amount of work, particularly for the section of the Bureau auditing the accounts of the field agents.

To increase the efficiency of the service, to prevent delays, and to secure the highest degree of cooperation with the Consular Service, arrangements were made that requests from American business men to the attachés for commercial information be transmitted through the Bureau. In many instances the information desired can be easily and fully supplied by the Bureau in Washington, or by its branch offices, and the delay in awaiting replies to direct requests is thus avoided. The commercial attachés are not themselves equipped with clerical assistance to care properly for miscellaneous inquiries of this kind. Moreover, the Consular Service, in its trade promotive activities, is often in position to supply the information sought, and an effective system of cooperation between the Department of Commerce and the State Department enables the Bureau to refer to that Service the inquiries that it can advantageously care for. The prompt and efficient handling of this correspondence between American business men and the attachés and between the Department of Commerce and the State Department requires supervision and clerical assistance not now provided for by law.

The proper administration of the attaché service necessitates the employment of some one who is thoroughly familiar with the Diplomatic and Consular Service of the United States and who is intimately acquainted with the aims and activities of the Department of Commerce and of this Bureau. The scope of the work to be undertaken by the attachés must be determined with due regard to the activities of the diplomatic and consular officers and instructions must be formulated with care in order to avoid any duplication of effort.

The attachés in the performance of their duties must be kept in close touch with the activities of the Bureau and with developments in commercial affairs of the country. It devolves upon the Bureau,

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therefore, to keep them currently informed of these matters, especially as they are frequently called upon to supply information regarding American business interests and American commercial affairs to foreign inquiries.

The volume of routine work is increasing rapidly. The attachés are furnishing many reports intended for publication, which are handled by the regular editorial force of the Bureau, but a large part of their work is carried on by correspondence with the Bureau, and, through the Bureau, with American interests. The development of the service since its establishment clearly shows that its success will prove an embarrassment to the Bureau unless adequate provision is made for directing the work.

The work of the various attachés is described in detail elsewhere in this report.

LATIN-AMERICAN SECTION.

The opening of the Panama Canal and the decreased European competition focussed public interest on Latin America as an export field. Fortunately a special appropriation of $50,000 was available for promoting commerce between the United States and South and Central America. The bulk of this has been devoted to the carrying on of special investigations in South and Central America, but it has also been possible to organize the Latin-American work of the Bureau in Washington so as to make it much more effective. A Latin-American section has been created and an expert appointed, whose functions have been to supervise the work of the special agents in South and Central America and to coordinate the work on these sections performed by the other divisions of the Bureau. This section has also been able to furnish much information to American manufacturers, both through conferences and correspondence, and to collect and publish much of the information on hand in the files of the Bureau. In view of the importance of Latin-American work at this time, however, it is highly desirable that the office organization should be enlarged, and it is to be hoped that the facilities of the Bureau will permit the carrying out of the plans already formed for bringing this about.

In addition to the work of the special agents in Latin America, which is detailed elsewhere in this report, valuable service has been performed in promoting our Latin-American trade by the four commercial attachés in South America as well as by the American consular officers, reports from all of whom have been published through the Bureau. Arrangements have been made so that in carrying on investigations and making reports the special agents, commercial attachés, and consular officers all work in full cooperation, and the work of none of them is duplicated.

The Latin-American section has been able to furnish to prospective exporters considerable information, both through correspondence and through personal interviews, at the Bureau. Visitors seeking information concerning South and Central America have been numerous and in nearly every case have received the data most desired. Conferences with manufacturers on the part of experts in the Bureau constitute a most effective method of reaching and instructing the public, and the Bureau hopes to expand this feature of

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its work. The Latin-American section has also been engaged in collecting and publishing the information on Latin America at present available in the Bureau, supplementing this with material obtained from other sources. In 1913 a report on "South America as an export field" was published, and several reprints of this monograph have been made. A pamphlet containing a brief synopsis of each of the special publications of the Bureau giving information on Latin America, and also one containing extracts from consular reports giving expert advice on the winning of Latin-American trade, have been issued. An inquiry for an estimate as to the probable increase in our trade with South America in 1915 resulted in the compilation of considerable data on the subject, and this was published later as a confidential circular. A folder emphasizing the principal points to be noted by American manufacturers in entering the South American field was prepared by the section, and copies have been inclosed in correspondence on this subject. The Bureau plans to continue this work of collecting and publishing data available in Washington, as a large amount of material, not only in the Bureau but also in other Bureaus and Departments and in the Library of Congress, is available and can be utilized to advantage.

The Bureau is thus accomplishing as much for the extension of Latin-American trade as its present resources will permit. Aside from the routine work on Latin America, which consists of answering inquiries and transmitting notices of specific trade opportunities through the usual channels, the new work undertaken, as noted above, has included the collating of information now on hand, the gathering of data on special lines of goods, and the removing of various trade obstacles of a general nature through the commercial attachés. The Bureau has also cooperated with the Treasury and Post Office Departments, the Pan-American Union, the Chamber of Commerce of the United States, and other official and semiofficial organizations in the work of promoting trade with Latin America, and has furthermore been able to disseminate effectively, through the branch offices and the visits of special agents returned from the field, whatever information has been obtained.

COMMERCIAL AGENTS.

All told, there have been working in foreign countries during the fiscal year 1915 twelve special agents of this Bureau, reporting on commercial and financial conditions in the countries which they visited. Of these ten were in Latin America and two in the Far East. In addition to these Dr. E. M. Borchard was detailed from the Library of Congress to make an investigation into the commercial laws and practices of South American countries, and sailed on June 12. A list of the twelve special agents, with the subjects which they were working on, follows: S. S. Brill, hardware, South America; L. L. Bucklew, furniture, South America; H. N. Douthitt, electrical appliances, Brazil; E. H. Gueydan, transportation, Colombia and Venezuela; Garrard Harris, general trade information, Central America; L. B. Hoit, general financial and business conditions, Mexico; Benjamin Joachim, wearing apparel, Central America; W. H. Lough, finance and credits, South America; J. A. Massel, machinery and machine tools, South America; Ralph M. Odell,

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cotton goods, China; R. E. Simmons, lumber and lumber products, South America; Franklin H. Smith, lumber and lumber products, Far East and Australia.

The results of the work of these agents, while difficult to measure, are of the highest value to American exporters in general and particularly to those dealing in the goods reported on. Each agent has been impressed with the prime importance of reporting definite details of the trade rather than generalities in order that the American manufacturers can take the final report when it is issued and determine from that what prospect he has of marketing his goods in the territory covered and what would be necessary for him to take into account if he wished to enter the field. Information of this sort naturally has certain limitations which can not be overcome. It can not take the place of the knowledge that would be gained by first-hand observation on the part of the manufacturer himself, but it is the Bureau's aim to furnish information so definite that its value to the manufacturer will be second only to such first-hand information. Two illustrations of what has been accomplished in this direction may be given: The Bureau is now issuing a comprehensive report on cotton goods in China, which discusses every phase of the market. This information is rendered doubly valuable by a large collection of samples of cotton goods sold in China, with full descriptions and prices. Both the report and the samples are made available for the study of our cotton goods manufacturers interested in the export trade, and with the aid of these they should be able to decide accurately as to the possibilities which the market holds for them. The same sort of detailed information, with samples, has been obtained respecting hardware in the principal South American countries. The report on hardware is also provided with a considerable number of illustrations of hardware articles on the South American market, which show clearly the differences in details between those articles and the products of American factories.

Similar information has been obtained with respect to machinery and machine tools, and lumber and lumber products, in South America, and lumber and timber in the Far East. Besides these reports on specific lines, other agents, as noted, have been collecting general commercial information and detailed data on transportation and finance. The Bureau expects to continue this work of the compiling of general information for the use of our exporters as well as special information for those handling particular lines. With the greatly increased facilities for distributing this information through the eight branch offices in the United States, the reports of these agents should not only stimulate an interest in foreign trade in every part of this country, but should go far toward supplying the information necessary to enable our manufacturers to build up their foreign trade.

It has been the practice of the Bureau to have these agents, with occasional exceptions, make a tour of this country before leaving for their fields. This tour sometimes lasts a month and sometimes only a few days. The purpose of this trip is twofold—to assist the agent in securing definite information as to the points which manufacturers would like to have investigated and to arouse the interest of the manufacturers themselves in the proposed investigation. In the

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future the Bureau intends to have each agent make a thorough report on the results of his conferences with manufacturers, and in this way will be enabled to ascertain the agent's ability in report writing, a very important qualification. The report rendered will then be taken up in the Bureau and gone over with the agent and he will be instructed as to what changes are necessary in his method of reporting. The agent before starting out is required to make out a tentative itinerary, showing the dates on which he intends to arrive at and depart from the principal cities he visits. He also confers with the officials of the Bureau and receives detailed written instructions.

A system of selecting agents for future field work has been worked out. An appointment committee has been established which secures through correspondence and otherwise a list of names of those qualified for carrying on any proposed investigation. After securing the applications of these men for the position, an examination is held and the best available man selected. It is considered that this method will bring to the Bureau the services of highly competent men, whose work under the close direction of the Bureau will result in even better reports on foreign commercial conditions than have heretofore been obtained.

BRANCH OFFICES.

The work of the branch offices maintained by the Bureau assumed such proportions during the past year that it was felt that some provision should be made in the main office for properly directing this work. Because of the limited force available for this purpose it was found necessary to assign this duty to a clerk in charge of a division already established in the Bureau. This arrangement is not entirely satisfactory, as it is manifestly impossible for this man to devote the amount of time and attention which are required for such important work. However, a vast improvement has been noted in the efficiency of these offices since the present plan was adopted. During the brief period that this arrangement has been in force a number of changes have been made in the manner of performing the current work of the branch offices which have added to their usefulness, without in any way impairing the service rendered to the communities in which they are located.

Various forms have been adopted to simplify the manner of handling correspondence in connection with requests received for special information which the branch offices are in a position to furnish. Suggestions made by the commercial agent in charge of one office, which are found to be of practical value in carrying on the work of that office, are immediately recommended for adoption by the other branch office managers and in this manner each office is able to profit by the experiences of the other offices. It has been found especially valuable also to have this work concentrated as much as possible in the Bureau, as information is readily available in regard to important matters which may be pending relative to branch-office administration. Efforts have been made to render as nearly uniform as possible the methods of filing and handling other current work in the branch offices. The natural growth in the work performed by these branch offices will necessitate additional clerical assistance for properly handling these matters in the main office, and it is hoped that

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some provision may be made for properly equipping the Bureau to carry on this work during the next fiscal year.

The Bureau at present maintains branch offices in the following important commercial centers of the country: New York, Boston, Chicago, St. Louis, Atlanta, New Orleans, San Francisco, and Seattle.

These branch offices are the stimulators and developers of foreign and domestic trade in their particular districts. They were established to bring the work of the Bureau of Foreign and Domestic Commerce into immediate and personal touch with the individual manufacturer and merchant. They are not merely distributers of information which has been collected at Washington, but they collect information and keep the Bureau at Washington in constant touch with the business communities. The reports received from these branch offices carry so well the expression of public opinion in the business community of each particular district that the Bureau is constantly well informed concerning every important development and every sentiment of weight which may arise in any part of the country.

The work of the commercial agents in charge of these branch offices of the Bureau may be summarized briefly as follows: Supplemental work in distribution of information collected by the Bureau; special investigations for the Bureau; arranging conferences between American consular officers and special agents who have returned from abroad and business men interested in foreign trade; aiding foreign purchasers in forming desirable connections with American manufacturers and exporters; conferring with commercial organizations and business men in regard to trade conditions at home and abroad; and sales of Government publications.

An incident which occurred during the past year illustrates in a striking manner the assistance rendered to foreign buyers by our branch office managers. A representative of a foreign iron and steel concern visited the United States to make purchases for his house. He was primarily interested in the products of certain firms in Pennsylvania and Ohio. The commercial agent in charge of the Bureau's branch office at Chicago, who is an expert in those lines, was instructed to accompany this purchasing agent and to render any assistance within his power. As a result of the visit of this foreign buyer large orders were placed, and a letter to the Bureau attested his appreciation of the service rendered by the commercial agent.

The recent tours of this country by the representatives of the commercial organizations of China and the delegates to the Pan American conference at Washington also served to point out the usefulness of these branch offices. These foreign visitors made their headquarters in the branch offices of the Bureau, when in cities containing such offices, and the commercial agents without exception were appointed to serve on the most important committees designated to look after the welfare of these distinguished visitors. They also made the necessary arrangements for conferences with business men, etc. The commercial agent in charge of the branch office of the Bureau at New York was appointed a representative of the United States Government to meet these delegates upon their arrival in this

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country and accompanied them during the entire tour. It is confidently believed that much actual business will result from the visits of these business men to the various cities of the United States, and the branch offices of this Bureau will play no small part in obtaining the ultimate results.

The branch office of the Bureau in New York, which was the pioneer in this new field of endeavor, was established in July, 1913, with Commercial Agent George W. Doonan in charge. At the outset this office consisted of desk space in one of the rooms in the United States Customhouse. In less than two years the work has increased to such an extent that four rooms are now required to carry on the current work. Commercial Agent E. C. Porter is at present in charge of the office and has six assistants. The office now occupies Rooms 407–413, United States Customhouse, and a recent report from the commercial agent in charge of the office states that the routine work for one month included the receipt of 6,000 letters and the mailing of 5,000 Foreign Trade Opportunities, while 1,000 visitors desired information in regard to trade conditions at home and abroad.

The commercial agent in charge of the New York branch office covers the territory included in the States of New York, New Jersey, and Connecticut; also the eastern portion of the State of Pennsylvania and portions of the State of Delaware.

The second branch office established was at Chicago at the beginning of 1914, and Commercial Agent H. H. Garver was assigned to take charge of the office. The work in this office has also shown a very satisfactory growth and pleasant and commodious quarters are now occupied by the office at Rooms 503–505 Federal Building. Upon the resignation of Mr. Garver to accept the position of foreign trade commissioner of the Chicago Association of Commerce, Dr. W. C. Huntington was placed in charge of the office. He has three assistants in this work.

Included in the territory assigned to the commercial agent in charge of the branch office at Chicago are the States of Illinois, Iowa, Michigan, Wisconsin, Minnesota, Ohio, portions of the States of Indiana, North Dakota, and South Dakota, and Pittsburgh, Pa. Commercial Agent Huntington also has supervision of the cooperative branch offices in the Chamber of Commerce at Cleveland and the Chamber of Commerce at Cincinnati, Ohio.

The branch office at New Orleans was established about the same time as the office in Chicago, and Commercial Agent E. E. Judd, who was for a considerable period employed in the Bureau at Washington, was designated to take charge of the work. Mr. Judd has one assistant in this office, which is located at Room 1020, Hibernia Bank Building. To this office has been assigned the following territory: Louisiana, Florida, Alabama, Mississippi, Texas, and portions of the States of Oklahoma, Arkansas, and New Mexico.

The branch office of the Bureau at San Francisco was established with Commercial Agent Dr. E. A. Thayer in charge. The office is now located at 306 Customhouse, and Commercial Agent E. G. Babbitt, who was appointed after the resignation of Dr. Thayer, directs its work, with one assistant. Commercial Agent Babbitt covers the States of California, Nevada, Utah, Arizona, and the western portion of the State of Colorado; he also has supervision of the cooper-

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ative branch office of the Bureau in the Chamber of Commerce at Los Angeles.

The branch office at Boston is located in Room 752, Oliver Building, but it is expected to move this office on October 1 to more commodious quarters in the new United States Customhouse. Commercial Agent F. L. Roberts, who was formerly employed in the Bureau at Washington, is in charge of the work and has one assistant.

The district assigned to the Boston office includes all of the New England States except Connecticut.

Commercial Agent W. A. Graham Clark is in charge of the branch office of the Bureau at Atlanta, which is located in Room 521 Post Office Building. Mr. Clark was formerly a special agent of this Bureau and traveled abroad for a number of years investigating foreign markets for textiles. He is frequently called upon for information along these lines at the present time. Mr. Clark also has one assistant.

The work performed by Commercial Agent Clark covers Georgia, South Carolina, North Carolina, Virginia, West Virginia, Tennessee, and a portion of the State of Kentucky.

The branch office of the Bureau at Seattle is located in the Alaska Building, and Commercial Agent W. B. Henderson is in charge of the work. Mr. Henderson was for a number of years employed in the Bureau at Washington. He has one assistant in the office.

The territory assigned to Commercial Agent Henderson includes the States of Washington, Oregon, Idaho, Montana, Wyoming, and the western portions of North Dakota and South Dakota.

The last branch office of the Bureau to be established was at St. Louis, Mo. Commercial Agent George W. Doonan, who was formerly in charge of the branch office at New York, was assigned to duty in this office, with one assistant. Commercial Agent Doonan has charge of the territory included in the States of Missouri, Kansas, Nebraska, and portions of the States of Illinois, Indiana, Kentucky, Arkansas, Oklahoma, New Mexico, and Colorado.

RESEARCH SECTION.

At the beginning of the fiscal year 1915, four clerks performing certain classes of work on allied lines which had previously been carried on independently, or as incidental to the work of the different divisions, were grouped to form the research section. The regular work of the section, as originally outlined, included the following: General translating from foreign languages into English; abstracting in English articles published in foreign languages; the preparation of the Statistical Abstract of the United States; the compilation of special tables of statistics of the exports and imports and other commercial statistics of foreign countries; making "bibliographies" of published and unpublished commercial reports of United States consuls on particular subjects, as needed to answer special inquiries. Gradually the research section came to be regarded as a place of last resort for information on subjects which did not fall within the domain of any of the other divisions.

The three outstanding features of the work of the section during the fiscal year were (1) the improvement and extension of the trans-

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lating and abstracting service, (2) arranging for the more extensive use of the commercial statistics of foreign countries, and (3) the increased use of the (unpublished) trade letters prepared by the American consuls.

In February a chief translator with a salary of $2,000, was appointed and added to the research section. The first important piece of work undertaken was the miscellaneous translation required in the compilation of a comprehensive review of economic conditions in foreign countries for the period following the outbreak of the European war; numerous translations and abstracts were made from foreign official publications and foreign economic and trade reviews. In May, the chief translator resumed his regular duty of making translations and abridgements of current commercial reports for publication, and during the remainder of the year devoted the bulk of his attention to such work. A number of important articles appearing in foreign publications have been reproduced, either complete or in summary form, in Commerce Reports.

The trade letters received from the American consuls have, in the past, not been used so extensively as they deserve to be. Some years ago these trade letters were arranged so as to make them accessible, but the work of collating them was not completed until May, 1915, when one of the clerks in the division took up the task of rearranging the trade-letter file. After several weeks the rearrangement was completed and the information contained in the thousands of unpublished letters from our consuls was made much more useful than it had ever been before. The Bureau was, accordingly, enabled to furnish more detailed replies to the perplexing and ever-changing inquiries which were referred to the research section.

During the forthcoming year the work of translating and abstracting foreign publications will be one of the most important features of the research section's program. There will be, in addition, an increased amount of statistical research relating to the trade statistics published by the governments of foreign countries. Consequently, it is expected that the work for publication will greatly increase during the forthcoming year.

On the other hand, the collation file of trade letters from the United States consuls was, at the end of the year, transferred to the section of trade information and the "bibliographies" and references to reports on trade opportunities, trade conditions in foreign markets, and like subjects, will be prepared in the latter division.

CORRESPONDENCE SECTION.

During the past year, and especially since the outbreak of the war, the demands for information received by mail have indicated a desire on the part of American manufacturers and business men generally for accurate facts regarding foreign markets. These inquiries have covered a wide range of subjects and have required the most painstaking care in order to furnish answers to the many concrete questions which were contained in the correspondence.

This section alone prepared 88,000 replies to requests for trade information during the last fiscal year. The volume of correspondence showed a marked increase, as may be seen by comparing the figures of this year with the preceding one when the average num-

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ber of letters sent out by the correspondence section was approximately 68,000. These figures do not include the technical letters written in other divisions of the Bureau.

The requests for trade information necessitate not only research in the publications of the Bureau but also an examination of foreign official journals, trade papers, and other documents issued in foreign countries. This work was done through the aid of translators in the research section. Furthermore, many of the communications requested information that it was not within the province of this Bureau to furnish. Most of these inquiries, however, were referred to appropriate individuals, firms, and associations outside the Government service which were in a position to give the information desired. Service of this kind is performed by the aid of a very comprehensive index called "Sources of information" which contains references to foreign and domestic private trade services. This index includes references to such sources of information as: Banks with foreign departments; commercial education; commercial organizations, domestic and foreign; contractors for foreign business, including loans; directories, domestic and foreign; experts, technical and otherwise; geographical information; information agencies outside of Bureau; industrial development; publications, Government and private; shipping, classified information regarding the different countries.

The clerk in charge of statistical correspondence has besides this work prepared brief analyses of the significant developments in foreign trade as disclosed by the figures of the "Monthly Summary"; prepared for the Department the monthly advance notices on imports, exports, and trade balances; and from time to time prepared press letters on subjects of such broad interest as to bring before the public the general scope of the Bureau's activities. As a result of this activity, there has been an increased demand for the official publications upon which these press letters are based, and a wide interest manifested in the statistical work of the Bureau.

DISTRIBUTION SECTION.

At the beginning of the last fiscal year a separate section was organized to take care of the work of distributing the various monographs, confidential circulars, press statements, and other literature published by the Bureau. This branch of the service is known as the section of distribution, and is in charge of a clerk of class 2. He has as his assistants two clerks.

Exporters' index.—As an implement of distribution the section has built up what is known as the "Exporters' index," which contains the names of approximately 15,000 firms who have informed the Bureau of their interest in export trade. This file consists of cards classified by articles and countries. The names recorded in the index were obtained largely through the medium of circularizing firms from lists furnished by collectors of customs, American consular offices, and commercial associations. All letters received by the Bureau relating to export trade are sent to this section and compared with the index. If found not to be recorded thereon, an appropriate form calculated to elicit the information desired is sent to the firm for execution.

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Miscellaneous lists.—The section also maintains a number of miscellaneous lists which are used for the distribution of information. These include local commercial associations in principal cities, national industrial associations, trade journals, export commission houses, freight forwarders, foreign buying agents, manufacturers' export agents, banks with foreign departments, traffic officials of railroads, and steamship companies.

To these various agencies are sent special circulars with regard to trade openings abroad or circulars describing important monographs issued from time to time by the Bureau. In a large measure most of these agencies render supplementary service in the way of advising their clients with respect to various publications which might prove of interest to them.

It is deemed advisable to give a full description of the various lists referred to.

Commercial organizations.—The Bureau has established a record containing the names of over 5,000 international, national, State, interstate, and local commercial associations. This information was compiled for publication in the form of a directory which will contain many detailed facts relating to annual income, number of members, and various important departments or bureaus maintained by the organizations. For the purpose of distributing trade information a list of associations in about 50 leading cities in the United States, and another list of manufacturers' associations classified by subject, are used.

Trade journals.—A list of trade papers, which contains about 600 names classified by subject, is used by the Bureau in distributing circulars about special publications relating to specific lines of trade. For example, the forthcoming monograph "Markets for American lumber in Japan", which is a report from Commercial Agent Franklin H. Smith, who recently visited that country, will be sent to all the trade journals in the United States who are interested in lumber. Frequently statements relating to foreign commerce of particular articles, or lines of articles, are sent to trade journals likely to be interested in the subjects covered.

To the other agencies mentioned are sent notices about monographs, especially those of miscellaneous character, like handbooks of foreign countries, those relating to foreign laws governing commercial travelers, consular regulations, and similar information. Besides distributing the circulars referred to, the section looks after other work which is proving of much benefit to manufacturers throughout the country.

Photostat work.—Every few days there is received in the office some document or illustration from consular officers which it is deemed advisable to reproduce in large numbers through the use of the photostat process. In each case a special schedule is prepared by the section, indicating the various branch offices and associations to whom photostat exhibits should be sent, thus determining the number of copies to be made and distributed.

Foreign trade opportunities—supplemental distribution.—Each week the file of letters from firms applying for the reserved information connected with the "Foreign Trade Opportunities," published in Commerce Reports, is examined to determine the notices for which

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there have been relatively few calls for the reserved particulars connected therewith. Marked copies of the Commerce Reports are accordingly sent to the various firms recorded in the Exporters' Index as interested in the particular line covered who did not make application for the information referred to. Many letters have been received from the firms thus favored, intimating their appreciation of the value of this supplemental service.

The section also undertakes to distribute to the firms in the Exporters' Index marked copies of Commerce Reports containing a series of reports of the particular line of trade in which they are thought to be directly interested. For example, if Commerce Reports contains a comprehensive article about the opportunities to sell cotton goods in India, marked copies of this particular number would be sent to all firms recorded in the Exporters' Index as interested in foreign markets for cotton textiles.

Lists of foreign buyers.—The section maintains a file of miscellaneous firms in foreign countries who import American products or are in a position to do so. These lists, which run into the thousands, are furnished from time to time by the consular officers in connection with reports in regard to particular lines of trade. A number of copies of the lists are reproduced on the mimeograph, and made available not only to persons who have read the published article but to individuals and firms who apply to the Bureau for names of foreign dealers.

Statement of material distributed.—Table 10 gives a statement of the various publications and circulars distributed by the Bureau during the past fiscal year.

TABLE 10.—CIRCULARS AND PUBLICATIONS ISSUED BY THE BUREAU DURING THE FISCAL YEAR ENDED JUNE 30, 1915.

Publications.	Number issued.
Confidential circulars	501
Press announcements	42
Press letters	39
Miscellaneous circulars	25
Monographs:	
Special agent series (Nos. 85–96, inclusive)	12
Special consular reports (Nos. 66–71, inclusive)	6
Miscellaneous series (Nos. 16–21 and 23–26, inclusive)	10
Tariff series (Nos. 28b, 30, 31, inclusive)	3
Foreign tariff notes (Nos. 13–15, inclusive)	3
Confidential bulletins (Nos. 28–32, inclusive)	5
Statistical publications:	
Annual volume of foreign commerce, and Tables 3, 5, 9–10 taken therefrom and published separately	4
Schedules and instructions (A, B, and E) for the guidance of collectors of customs in preparing returns of imports and exports	3
Statistical abstract of the United States, 1914	1
Monthly summary of foreign commerce	12
Statistical record of the progress of the United States, 1800–1914, from the statistical abstract	1
Monthly statement of total values of imports and exports of United States	11
Monthly statement regarding exports of domestic breadstuffs	11
Quarterly statement of imported merchandise entered for consumption and duties collected thereon	5
Monthly statement of sailing dates of steamships to foreign countries (discontinued Dec. 31, 1914)	5

ACCOUNTS SECTION.

The work of the accounts section consists chiefly of verifying accounts presented for payment, maintaining a record of the funds

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disbursed from the various appropriations under the direction of the Bureau, preparing statements as to the costs of the various investigations, instructing field employees with regard to the method of rendering their accounts, and keeping a record of the movements and addresses of employees traveling in the field; the section has also, during the past year, carried on a considerable portion of the correspondence relating to personnel.

The work has greatly increased during the past year as a result of the increased appropriations for the fiscal year 1915, which affected chiefly the field service of the Bureau, and consequently increased the number of accounts that had to be audited. For the fiscal year $100,000 was appropriated for the commercial attaché service, $75,000 for the promotion of commerce, $50,000 for the promotion of commerce with South and Central America, and $50,000 for investigating cost of production, in addition to the appropriation of $122,180 for the salary of statutory positions in the Bureau, and the allotment of $5,325 for contingent expenses, while the appropriation act provided for the fiscal year 1914 but $60,000 for the promotion of commerce, $10,000 for collating tariffs, $104,860 for statutory positions, and an allotment of $3,000 for contingent expenses.

During the fiscal year there were passed for payment approximately 1,700 vouchers covering salary and traveling expenses of employees in the field, purchases of supplies, equipment, etc., and other miscellaneous services. Approximately 3,700 letters were written and 240 travel orders issued in addition to the preparation of numerous statements showing the condition of the various appropriations, expenditures made for various investigations, and names of persons employed under the various lump-sum appropriations.

There were employed in the field 103 employees, including the commercial attachés, their clerks, and the employees in the branch offices of the Bureau. A number of these were, however, employed for but a short period. Of the employees in the field, 27 were appointed special disbursing agents to enable the Department to advance funds to them out of which to make expenditures for salary and traveling expenses while abroad.

Considerable difficulty has been experienced in auditing accounts during the past year as a result of the law limiting expenditures for subsistence to $4 per diem in lieu of actual expenditures, or actual expenditures not to exceed $5. Since it is held that charges for laundry, pressing clothes, fees paid to waiters, etc., are considered as subsistence expenditures chargeable against the subsistence allowance on the date that payment is made, the legal maximum limit has necessitated numerous suspensions in the accounts of field agents and much supplemental correspondence to determine the exact date upon which payment was made, especially in the case of receipts for laundry.

VIII.

COOPERATION.

I wish to call your special attention to the cooperation which this Bureau has received from other departments and from the other Bureaus of this Department. In this connection I wish to mention especially the constant cooperation and assistance which we have had from the Consular Service of the Department of State. Our demands upon the Consular Service have been extremely exacting

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and very numerous, but we have had there the constant and unfailing cooperation of the director and of every member of the Consular Service. I wish to recommend highly the constantly improving work of our consuls in foreign countries, and this Bureau, as well as the business public, owes them a debt of gratitude. It is remarkable, in view of the variety of their work, the pressure of it, and the inadequate assistance and inadequate salaries, that the American consuls are able to turn out such good work and in such considerable quantities.

Incidental to the close cooperation between these two Government bureaus, was the willingness of the Director of the Consular Service to send out, over the personal signature of the Chief of the Bureau of Foreign and Domestic Commerce, to each and every consul in the Consular Service, a statement concerning the work of the Bureau of Foreign and Domestic Commerce. It had appeared to me that the consuls would be interested in such a statement from the Chief of this Bureau and, with that idea in mind, a letter of some length was composed, describing our activities and requesting the cooperation of our consuls. It is the ordinary custom that such communications to the American consular officers shall be sent out only over the signature of the Director of the Consular Service. It seemed to me, however, that better results would be obtained in this case by communicating direct with our consuls and the Director of the Consular Service agreed and assisted in every possible way. The consuls now know directly that the Bureau is interested in their work and they have also been given, perhaps, a better idea than they have had before of the scope of the work and our anxiety to increase its usefulness to the business public.

This Bureau has also had the closest cooperation from the office of the Foreign Trade Advisers of the Department of State, and this has been especially timely in view of the many negotiations which it has been necessary to make in order to expedite shipments of merchandise to and from the belligerent countries and the near-by neutral countries. We have found the Foreign Trade Advisers constantly cordial and helpful in their desire to assist in our work.

Other branches of the Government which have assisted us are the Bureau of Markets and the Bureau of Forestry of the Department of Agriculture, the Bureau of Mines of the Department of Interior, and particularly the Bureaus of this Department, namely, the Bureau of the Census, the Bureau of Navigation, and the Bureau of Standards.

Since the creation of the Federal Trade Commission this Bureau has been in close touch with the activities of that commission. It has taken up several matters in which the Bureau is interested, particularly the problem of cooperation in export trade and the prevention of dumping of European products into the American market. In these and in other matters the members of the Federal Trade Commission have been personally and uniformly cordial and helpful.

In its statistical work the Bureau depends upon reports from collectors of customs, covering the imports and exports of merchandise. These officers show a keen appreciation of the importance of this line of work and cooperate fully in the efforts to make the published statistics accurate, prompt, and of practical help to the business community. During the last fiscal year customs officials at ports as well

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as the officers of the customs division of the Treasury Department at Washington, have taken lively interest and have cooperated most cordially with the efforts of the Bureau to introduce improved methods of tabulation and to reform those features of customs practice that in the past have led to inaccuracy and have delayed the timely publication of the Monthly Summary of Foreign Commerce.

A special committee was designated by the Secretary of the Treasury, consisting of three officials of the customhouse at New York and two members of the customs division at Washington, to investigate the whole subject of statistical methods in reference to imports and exports. This committee met with a similar committee from the Department of Commerce and made a painstaking examination of recommendations submitted by one of the assistant chiefs of this Bureau.

This Bureau has also received invaluable aid from the Chamber of Commerce of the United States. A special committee appointed by that chamber to study and advise with the officers of the Department of Commerce gathered in the offices of this Bureau on April 19 and 20 and went thoroughly into the methods which are in use here. Many helpful suggestions were received from the committee and have been received from time to time from the officers of that Chamber of Commerce.

The Bureau is indebted to the chamber for the almost constant use of the columns of the Nation's Business. It is believed that the cooperation of this Bureau with a body representing the business men of the United States will be helpful not only to the Government's work but also to the business community at large.

IX.

PRACTICAL BUSINESS RESULTS.

It is my aim and the policy of the Bureau to make its work absolutely practical. Our work in promoting commerce would indeed be useless if actual orders did not result. While perhaps our work should not be entirely measured by the volume of orders which we hear about as having been taken by American manufacturers as a result of our work, nevertheless this is the principal and essential standard of the success of the work of the Bureau of Foreign and Domestic Commerce in promoting our foreign trade.

It is therefore proper that I should report to you instances of where our service has been especially effective and where definite, practical, concrete results have come about. I hope that you will not regard this as unduly boastful, but rather will regard it as a test of the effectiveness of the work of this Bureau.

Perhaps the largest order which has ever been placed, as far as we are aware, through the use of the service of this Bureau occurred within a few days of the end of the past fiscal year. A representative of a Russian concern had applied to the Bureau of Foreign and Domestic Commerce for assistance in getting in touch with concerns interested in exporting cotton. By means of a confidential circular this man's presence in New York City was made known to those who would be interested, and during a short stay in New York he made his headquarters at the offices of the Bureau there and formed con-

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nections with American concerns. One of those concerns informs us that they have just closed a five-year contract for 40,000 bales of cotton annually, which will amount, according to the market price, to from two to three million dollars annually or, during the life of the contract, to ten or fifteen million dollars. This is an especially noteworthy instance in view of two facts—first, that the product involved is the principal agricultural staple of a large part of the United States; and second, that the business is to be done direct with Russia, where very little direct business has heretofore been conducted.

We are also informed of four other specific instances of orders, each one of which amounted to a million dollars or more, the information concerning which was first published in our foreign trade opportunity service. These are: A railroad for the island of Formosa; a coal-handling plant for the port of Durban, South Africa; battleships for a South American republic; and arsenal machinery for the arsenal at Hang Yang, China.

Recently we were informed by a large milling concern in the West that a little over two years ago they formed a business connection with a concern in Turkey. The name of this concern had been obtained from the Bureau. During the past two years the amount of business done with this one concern has amounted to over $800,000.

Numerous instances have come to our attention where the results in each instance have been smaller, but nevertheless important. For example, information published as foreign trade opportunities resulted in a contract for a new telephone system for Bergen, Norway, amounting to $201,000, a contract for a petroleum pipe line at Bucharest, Roumania, a contract for the construction of the capitol at Taihoku, Formosa.

The conference of our commercial attaché with the King of Spain has already been referred to. It is worth while noting in this connection, however, that this one service which he has rendered to the American business public opens up a market for approximately 3,000,000 tons of American coal annually. Immediately upon receipt of the information from Madrid that the Spanish transport tax on coal had been removed, telegrams were sent out from this Bureau to the most important coal producers in the United States, and within three days a letter was received from one, stating that they had already got into cable communication with their representative in Madrid and had a cable for a considerable quantity of coal and were quite sure that a very large business would almost immediately develop.

Reference has been made earlier in this report to the work done by the commercial attaché at Lima, whose negotiations, if successful, will bring to this country for smelting vast quantities of Bolivian tin ore and will add to our total commerce not much less than $50,000,000 annually.

These results of the foreign trade service of the Bureau are practical and concrete because they deal with particular and specific opportunities for the sale of American goods. Our more general reports, however, are probably more valuable on the whole than these specific trade opportunities. They do not, it is true, point to a specific opportunity, but they give the manufacturer of the United States the information which is absolutely necessary with respect to his industry in certain foreign markets. With this information in

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hand he is able to so adjust his products and to so arrange his business as to successfully compete with foreign concerns in foreign markets.

Again, and finally, let me say that the Bureau aims to make its work practical and of assistance to the business men of the country. I sincerely desire, and I believe it is also your wish, that the Bureau should keep in closest touch with the manufacturers and exporters of the United States. I hope that we may have their constant suggestions and criticisms as to our methods in this work. I feel that it is only by this close cooperation between the offices of this Bureau and the practical business men that the work of the Bureau of Foreign and Domestic Commerce can be made most effective.

Respectfully,

E. E. PRATT,
Chief of Bureau.

To Hon. WILLIAM C. REDFIELD,
Secretary of Commerce.

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REPORT

OF THE

DIRECTOR OF THE BUREAU OF STANDARDS

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REPORT

OF THE

DIRECTOR, BUREAU OF STANDARDS.

DEPARTMENT OF COMMERCE,
BUREAU OF STANDARDS,
Washington, July 1, 1915.

SIR: There is submitted herewith a report of the work of the Bureau of Standards for the fiscal year ended June 30, 1915.

I. FUNCTIONS, ORGANIZATION, AND LOCATION.

Before describing in detail the various scientific and technical problems in which the Bureau of Standards is engaged, the following brief statement as to its functions and organization may be helpful to those unfamiliar with the subject of standardization in the broad and modern sense.

The standards with which the Bureau is authorized to deal may be conveniently classed as follows: Standards of measurement, standard values of constants, standards of quality, standards of mechanical performance, and standards of practice.

1. STANDARDS OF MEASUREMENT.

A standard of length may be taken as an example of a standard of measurement. It must be a length which is unchanging, reproducible, and capable of being compared with the working standards used in the most precise scientific work or with those used in commerce and industry. The fundamental standard must be subdivided and working standards prepared of these parts, for the measurement of greater lengths, standards must be prepared which are multiples of the fundamental standard. This process of subdividing and multiplying the standard involves difficulties as great as those met with in the preparation of the fundamental standard itself.

The construction of a set of standard weights from a single unit is also an illustration; a whole set of standard weights must be prepared before the standard weight of the Government can become available to the public. When the standard of length or weight has been found with as many desirable qualities as possible, and before the working standards of the subdivisions or multiples can be prepared the question as to the method of comparison arises, which again involves the solution of difficult scientific problems in connection with the balance or the methods used. These balances range from that capable of measuring the thousandth part of a milligram

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to the large testing machine capable of measuring a load of thousands of tons. The complete range must be covered, which involves not only a large number of working standards, all of which must agree with the fundamental standard, but apparatus suitable for the comparison of these standards with all of the lengths or weights found in practice.

These steps and equipment are absolutely essential in order to secure uniform measurements of length or weight throughout the country, and they have their counterpart in every quantity that has to be measured, whether it be length, weight, temperature, heat, light, or the various electrical measurements or other standards of measurement. These standards in one form or another are involved in practically every scientific investigation, industrial process, engineering structure or commercial transaction.

2. PHYSICAL CONSTANTS.

There are many fixed relations between physical quantities, the values of which it is extremely important to know. These values are usually termed "physical constants," and are used in every branch of scientific work or industry. The amount of heat required to change a pound of water into steam under normal conditions and the relation between heat and mechanical energy are two important physical constants; their values are used in practically every computation in connection with the designing of steam engines and boilers, the tests of their efficiencies, or the measurement of their output. The amount of heat required to turn liquid ammonia into vapor or the amount of heat required to melt a pound of ice are constants equally important in the refrigerating industries. The value of the relation between electrical and mechanical energy is involved in many important commercial transactions concerned in electricity.

Accurate and authoritative values of these constants are just as essential as in the case of standards of measurement. Many of these now in use are old and obsolete and need redetermination by means of the best modern facilities for physical measurement. Their determination involves the most difficult and precise work in all branches of physics and chemistry—a fact not generally known by those not engaged in the scientific or technical work where these constants are used.

3. STANDARDS OF QUALITY.

A standard of quality for a given material may sometimes take the form of a sample of that material with which other materials of the same kind can be compared, but this is generally a makeshift of the poorest sort. It is only resorted to in the absence of definite and reliable specifications in terms of measurable properties; that is to say, a standard of quality of a material usually takes the form of a specification or definition of its properties, involving, of course, the measurement of those properties by means of the usual standards of measurement. A certain kind of steel, a cement, a paint, an oil, or a paper or cloth is found by use to be good or poor. The question then arises, Why is it good or poor; what are the physical or chem-

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ical properties or the particular combination of elements which make it of good or poor quality; how are its properties to be measured or its constituents determined? These are questions for the laboratory to answer and involve physical and chemical investigations of the most difficult sort.

A standard of quality for a given material necessarily takes into account the purpose for which the material is to be used; to set the standard too low results in losses, poor efficiency, and even loss of life; to make it too high may result precisely in the same thing; that is to say, the material must be suitable for the purpose intended, and the Bureau's investigations in connection with the properties of materials are to enable the user of these materials, first, to select intelligently the material best suited for the purpose; second, to specify it in terms which the producer can not mistake; and third, to make the necessary tests to ascertain whether or not the material supplied is in accordance with the specifications.

The actual testing of materials by the Bureau of Standards to ascertain whether or not they comply with specifications is confined almost exclusively to Government purchases, but in making these tests (in which the Bureau has had the hearty cooperation of practically all the departments of the Government service) it is compelled to make many investigations concerning the properties of materials, their specification and measurement. While this work is of great value in placing Government purchases on a correct business basis, the results of the investigations as to the properties of materials and the information gained in testing Government supplies is even more important to the general public, and is distributed in the form of suitable publications.

The Bureau does not compete with private testing laboratories, but endeavors to assist them by the development of standard specifications, methods of measurement, and other matters where uniformity is desirable, much of which information, as stated above, is secured in connection with the testing of materials purchased by the Government and a close observation of their use.

The time is not far distant when it will be required that all materials bought or sold shall be as represented, but it should be kept in mind that this is impossible except in the case of those materials where proper standards of quality and methods of measurement have been developed. It must not be assumed that the purchaser or user is the party principally benefited in the development of such standards; on the contrary, the manufacturer, first of all, is interested in the quality of all things which affect the quality of his product, and while the Bureau's efforts in this field are devoted principally to the pointing out and measurement of those properties upon which the quality of the materials depend it is to be regretted that its force and equipment is insufficient to render more assistance to manufacturers with a view to a direct improvement of those parts of the process upon which the quality of the output depends.

4. STANDARDS OF PERFORMANCE.

The value of an instrument, device, or machine almost always depends upon the efficiency of its performance. In such cases it is necessary to state the performance desired or guaranteed in terms

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which are correct and susceptible of measurement. As in the case of standards of quality, the standard involved is more often in the form of a specification, but specifications are useless unless based upon correct scientific and mechanical principles and supplemented with a statement of the method to be used in ascertaining whether or not the specifications or guaranties have been complied with.

The performance of an engine or boiler, a pump, an electrical generator or motor, a weighing device, or a telescope can usually be measured, but the quantities to be measured and the method used must be specified correctly and understood by all the parties concerned in the construction, purchase, or use of such apparatus. To do this properly involves the use of standards of measurement, standard values of constants, and standards of quality. The Bureau of Standards does not attempt to cover this field completely, but only those cases where there is a lack of definite information upon which to base specifications and only to the more important classes of apparatus. To secure this information involves investigations quite as scientific in character and as difficult as in the case of other standards, as well as a knowledge of technical and manufacturing processes.

The Bureau's activities in this field have only been developed to a slight extent and almost entirely in connection with Government purchases. It has had in this, as well as in the field of the properties of materials, the most hearty cooperation of the various Government experts, manufacturers, engineers, and technical societies.

5. STANDARDS OF PRACTICE.

Standards of practice are generally involved in the enactment of laws when technical and scientific matters are concerned, in the ordinances relating to the regulation of public utilities, and in the establishment of building and safety codes. Like standards of performance, they are dependent upon standards of measurement and standards of quality and are of the most vital importance in questions pertaining to the welfare and safety of the public. In a field so broad the Bureau can touch only upon the more important aspects of the work, where National uniformity is desired—fields which can not be covered efficiently in private laboratories.

6. RELATION OF THE BUREAU'S WORK TO THE PUBLIC.

It is perfectly obvious, even to one unfamiliar with the subject, that the maintenance on the part of the Government of correct standards of measurement or quality or performance calls for continuous scientific and technical investigations of the highest grade, involving the most competent expert services and the best scientific equipment. When this is accomplished, there still remains the serious problem of making the results available and useful to the public.

The Bureau compares with its own standards of measurement the standards or measuring instruments of States, cities, scientific laboratories, educational institutions, manufacturers, Government bureaus, or the public, for which a nominal fee is charged, except in the case of the National and State Government institutions. It gives advice concerning these standards or their use, whether it be in connection with the enactment of laws, regulations, or ordinances concerning

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the weights and measures of everyday trade or in connection with precision standards used in scientific work and the industries. It gives advice upon request to State and city officials, public-service commissions, and public-utility corporations, regarding the standards of measurement, of quality or performance, involved in legislation or regulation pertaining to the public utilities. Many questions of disagreement between the public and utility companies as to these matters are referred to the Bureau for advice or adjustment, often avoiding unfair or inconsistent regulations, as well as long-drawn-out and expensive litigation. There is a great need on the part of the public for unbiased and reliable information pertaining to the standards entering into the regulation and sale of the services of public utilities. As far as possible such information is given in the form of publications upon definite subjects.

It must not be inferred from the above that the Bureau's activities are devoted principally to the interests of the user or consumer. The fundamental facts regarding standards of measurement, quality, or performance are the very things which most deeply concern manufacturers; they are fundamentally concerned, either directly or indirectly, with the improvement of methods of production or the quality of the output. It may be said that the Bureau occupies somewhat the same position with respect to the manufacturing interests of this country that the bureaus of the Department of Agriculture do to the agricultural interests. Many industries are just beginning to realize the importance of precise methods of measurement and scientific investigation, which, in practically every case, involve some kind of measurement.

It is upon quality as well as upon price that competition must finally depend, whether in domestic or foreign commerce. The use of exact methods and scientific results is the greatest factor in the improvement of quality, efficiency, or the development of new industries. The educational value of the Bureau's work in this respect is almost entirely unknown to the general public, and yet the Bureau receives hundreds of letters, as well as many personal visits from manufacturers, seeking information as to standards of measurement, how to use them, how to measure the properties of materials, or as to the fundamental physical and chemical principles involved; also, what is of even greater importance, how to initiate and carry out scientific investigations and tests on their own account in their particular fields of work.

The importance of maintaining scientific institutions having to do with standardization and the application of precise measurements to the industries has been recognized by all the leading countries of the world. Great Britain maintains the Standards Department of the Board of Trade, which is in charge of the standards and inspection service of the trade weights and measures; also the National Physical Laboratory, whose functions include matters pertaining to scientific and technical standards, physical constants, and to some extent the properties of materials. The Laboratoire d'Essais, of France, while not as extensive as the English institution, is charged with similar duties. Germany maintains three such institutions—the Normal-Eichungs Kommission, equipped with the buildings, personnel, and apparatus necessary in standardizing and controlling the weights and measures of trade; the Physikalisch-Technische

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Reichsanstalt, covering testing and investigations in connection with scientific and technical standards other than weights and measures; and the Prussian Government maintains the Materialprüfungsamt, a large institution devoted to the investigating and testing of structural, engineering, and other materials.

It is generally recognized that these institutions have been exceedingly important factors in the industrial progress of these countries.

7. RELATION OF THE BUREAU'S WORK TO THE GOVERNMENT SERVICE.

The bureaus of the Government engaged in scientific and technical work are necessarily dependent upon standards of measurement of every variety. In addition, many of them are engaged in the design, construction, and specification of a great variety of special apparatus, in which the principles of mechanics, heat, optics, electricity, and chemistry are involved and are vital to their efficiency and successful operation. In such matters the Bureau has been consulted most freely by the War and Navy Departments, the Post Office Department, the Department of Agriculture, the Public Health Service, and others.

The engineering and building construction in progress at all times by the Government is exceedingly great, both in variety and magnitude; in all of it a knowledge of the materials employed is of fundamental importance from the standpoints of economy, efficiency, and safety. The work of testing and investigating the properties of structural materials was taken up and is carried on primarily for the purpose of securing the information needed by the Government service in its structural work. This information is as necessary to the public in construction work, and every effort is made by the Bureau to make its findings in a form available to the public generally. The demands for information of this sort have come from practically all Government bureaus and establishments, but especially so in connection with the structural work carried on by the Office of the Supervising Architect, the engineering branches of the Army, the Bureau of Construction and Repair of the Navy, the Panama Canal, and the Reclamation Service.

The Bureau of Standards serves as a testing bureau for the various departments of the Government when called upon, and as such is assisting to place Government purchases upon an economical and businesslike basis. The example of the Government in such matters has a far greater influence upon the public than is generally supposed. The Government can do no greater service to the country than to place its own purchases upon a basis which may be taken as a standard by the public at large. This work involves the specification of a wide range of structural and miscellaneous materials and their testing when delivered to ascertain whether or not they comply with the specifications. This is especially important, since such materials are purchased by means of competitive bids, a method resulting in much fraud and injustice unless suitable standards are established and successful bidders held absolutely to this standard in making deliveries. Furthermore, most purchasing officers are realizing the great importance of having such testing done by a disinterested institution equipped with the scientific and other facilities for performing the service in a manner that is fair to both parties concerned in the purchases.

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Among the many Government bureaus and establishments which have utilized the Bureau of Standards as a testing institution in connection with the purchase of supplies may be mentioned the Government Printing Office, in connection with the purchase of paper, inks, and printing supplies; and the Post Office Department, in connection with the purchase of paper, twine, textiles, etc. A wide range of materials have been tested for the Quartermaster's Department of the Army, the Paymaster's Department of the Navy, and the Panama Canal. The General Supply Committee has called upon the Bureau for assistance in the specification of all sorts of supplies and equipment, as well as the testing of samples submitted by bidders of the supplies bid upon. Practically every branch of the Government service, including the District of Columbia, utilizes the Bureau of Standards as a testing bureau. Here again, as in other fields of the Bureau's activities, it gains much useful knowledge which is given to the public in the form of suitable publications.

Many bureaus of the Government service are charged with the administration of laws and the establishment of regulations in which scientific data are vital. This is true to a much greater extent than is generally supposed. The Bureau of Standards has cooperated freely with such branches of the Government and the service rendered has involved every department of physics and chemistry covered by the Bureau's activities. The neglect of such matters in the past has been a frequent source of misunderstanding and litigation between the Government service and the public. Conspicuous examples of bureaus to which such assistance has been given are the Customs and Internal Revenue Services; the Steamboat-Inspection and Coast Guard Services, in the promulgation of safety regulations; and the Bureau of Navigation of the Department of Commerce, in the administration of laws regulating the use and inspection of radiotelegraphy.

8. ORGANIZATION.

The organization of the Bureau's scientific and technical staff is based upon the nature of the expert service involved rather than upon the classes of standards. For example, the division of weights and measures has to do with all matters pertaining to standards of length, mass (weight, as it is commonly termed), time, density, and similar questions, whether they arise in connection with the precision standards used in scientific investigation, the master standards of manufacturers, or the ordinary weights and measures of trade. A standard of quality or performance where any of the above measurements form the fundamental and most important factor would be referred to this division.

The division of heat and thermometry has to do with heat standards, the testing of heat-measuring apparatus, the determination of heat constants, of which there are many, and all investigations pertaining to quality or performance where heat measurement is the essential and predominating factor.

Similarly, the electrical division is concerned with all the electrical problems that may be taken up at the Bureau, whether in connection with the various electrical standards of measurement, electrical constants, the electrical properties of materials, or the performance of electrical equipment.

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Questions in optics enter into standards of all kinds to a greater extent than has been supposed; hence, there is an optical division provided, with experts in spectroscopy, polarimetry (used in sugar analysis), color measurement, the principles of optical instruments, and the measurement of the optical properties of materials.

Practically all investigations concerning the various classes of standards involve chemistry in one form or another. There are also many chemical standards and questions which arise in connection with chemical work generally, especially in the industries; hence, there is a chemical division, cooperating with every other division of the Bureau, as well as taking care of the questions of a purely chemical nature that come to the Bureau and which fall within its functions.

In the case of the more important technical fields, divisions have been formed dealing more specifically with large and important classes of materials, but many of the purely scientific questions involved would be handled by one of the above-mentioned scientific divisions or jointly with it. The work of the technical divisions is just as scientific in character, but deals more specifically with manufactured products.

The work of the structural engineering and miscellaneous materials division includes the investigation, testing, and preparation of specifications for these materials, such as the metals and their alloys, stone, cement, concrete, lime, the clay products, paints, oils, paper, textiles, rubber, and other miscellaneous materials.

The division of engineering research makes investigations and tests regarding the performance and efficiency of such instruments, devices, or machinery as the Bureau may take up that do not fall directly under one of the scientific divisions. The division is a small one and its work is devoted almost exclusively to assistance given other departments of the Government and the General Supply Committee in designing, specifying, or testing equipment. It should in time form one of the more important branches of the Bureau's work.

The questions pertaining to the manufacture, specifications, testing, and use of the metals and their alloys have become so important that a division known as the metallurgical division has been formed of the experts engaged in these problems.

The employees engaged in clerical work, purchasing, files, records, accounting, and library, are known as the office division, while those employed in the operation of the mechanical plant, the various shops, and the care of the buildings and grounds form the engineering and construction division.

9. LOCATION.

The laboratories of the Bureau of Standards are located in the northwest section of Washington, on Pierce Mill Road, near Connecticut Avenue, and are reached by the Chevy Chase car line. It was located outside of the business center of Washington in order to insure freedom from mechanical, electrical, and other disturbances common to the business and more thickly populated sections of the city. Furthermore, the area of ground necessary precluded a site near the city. It has been found by experience that the efficiency of the employees, especially those engaged in testing and scientific inves-

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tigation, has been greatly increased by the location of the laboratories in a section free from the ordinary disturbances of city life.

II. SCIENTIFIC AND TECHNICAL DIVISIONS.

1. WEIGHTS AND MEASURES.

Weights and Balances.

Investigation of the constancy of analytical weights commonly used in chemical and physical laboratories have extended over a number of years. It has become increasingly certain that these weights are much less reliable than is generally assumed. Serious changes have been noted in many cases where there is known to have been no special cause for change.

Several high-grade precision balances have been investigated with special reference to the proper placing and alignment of the knife edges, and also as to the straightness of the knife-edges and bearings. This preliminary work has given information on which it will be possible to base more intelligent study of these points with a view to establishing specifications and more satisfactory methods of testing these balances. Both makers and users of analytical and other high-grade balances are greatly in need of standard specifications and methods of testing these balances.

Plans for equipping the high-precision weighing room secured at the close of the preceding year were partially developed, but could not be completed because of the pressure of other work.

Of the 3,355 weights tested during the year, 1,884 were for cities, firms, individuals, etc., and 1,471 were for various branches of the Federal Government, the State governments, and State institutions.

The large number of tests for State governments show the continued interest in weights and measures inspection. The purchase by several of additional standards shows the expansion of the State work. This is especially noticeable in the case of apothecaries' and metric denominations.

Capacity and Length Measures.

There were tested during the year 70 capacity measures, including the standards of several States, and 362 length standards, of which 27 were tapes of the nickel-steel alloy. This alloy, because of its low coefficient of expansion, is being increasingly used for precise surveying operations.

An improved method for testing cubic-foot bottles has recently been developed which is more rapid than the usual method and the equipment required is less expensive. Instead of using a large and expensive balance for weighing first the empty bottle and then the bottles filled with water, use is made of Archimedes' principle in a very simple and comparatively inexpensive piece of apparatus. By this method one man can test a cubic-foot bottle in about twenty minutes, whereas the ordinary balance method requires two men about an hour. It is expected later to apply this method to the testing of large capacity measures.

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Sieve Testing.

There were 225 standard sieves or pieces of wire cloth tested during the year. These included, besides the usual 100-mesh and 200-mesh sieves used in fineness determinations of cement, several sets of graded sieves for testing other materials. The pieces of wire cloth included a number of samples of bronze window-screen cloth for use in the Panama Canal Zone, of which measurements were made to determine whether the mesh and diameter of the wires conformed with the specifications.

Sieving screens are used in a large number of industries and there has been a considerable demand for a recognized standard screen scale in which the screens bear a simple and definite relation to one another. For the purpose of establishing such a scale, the Bureau has been making inquiries of the manufacturers using wire sieves in grading or testing their products to determine the sizes of sieves most used, with a view to preparing specifications for a scale of screens which may be suitable for all industries making use of sieves. A final decision has not as yet been reached in this matter.

Volumetric Glassware.

The glassware tested by the Bureau comprises flasks, cylindrical graduates, transfer pipettes, measuring pipettes, burettes, and Babcock test bottles. A great deal of this testing is done for various branches of the Government service. There has been a very considerable falling off in the number of pieces of volumetric glassware submitted for test during the year, only 1,632 pieces being received; but the lessening of work on this account has been more than counterbalanced by the 2,306 hydrometers submitted, against 1,213 last year, and 309 density determinations made, against 109 the previous year.

Density determinations on samples of sea water were made during the year in connection with the ice patrol being carried on by the Government in its safety work on the North Atlantic Ocean. It is expected that further samples will be collected and their densities measured at various temperatures, in order to determine the relations existing between density, temperature, and salinity of sea water.

Density Tables for Petroleum Oils.

Petroleum-oil tables were prepared during the year and will be published in the form of a circular. The density and expansion of American petroleum oils obtained from the oil fields of California, Indiana, Louisiana, Ohio, Oklahoma, Pennsylvania, and Texas were determined, and form the basis of the tables. These tables, comprising about 100 pages, will be found of great practical value in the oil trade in various ways, such as in calculating the number of gallons of oil in large shipments when the quantity is determined by weight and in ascertaining the quantity of oil in storage tanks.

Barometry.

Apparatus has been constructed and used for calibrating aneroid barometers at —35° C., the cooling being done by carbon dioxide and the temperature controlled by lamps and fan in a vacuum chamber.

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Investigations of aneroid barometers previously conducted by the Bureau have been confined to the inherent errors of the instruments. The consideration of secular or of transient errors, being less urgent, was not taken up for careful study until the present year. Regarding these latter errors, certain facts have been established by suitable experiments, (*a*) concerning the nature of the changes occurring in use and transportation, and the causes giving rise to them; (*b*) concerning the temperature lag of the air, inside the aneroid, or the time needed for the temperature difference to drop to about one-third of its initial value, which was found to vary according to the style of case and degree of circulation of air and from which conclusions were drawn as to the time necessary in test. It further appears that transient thermal errors are wholly due to this temperature lag, and not to local heating.

It has been found by experiment that aneroid barometers may be successfully compensated against temperature effects at constant pressure, but still go seriously in error when temperature and pressure are both changed. Apparatus has been constructed for changing the temperature and pressure at the same time. The specification of this error has been reduced to a quantitative basis, and has been called the temperature coefficient of scale value to distinguish it from the previously recognized temperature coefficient of reading.

During the year 16 aneroid and 7 mercurial barometers were tested.

Testing of Watches.

The testing of watches for the public, a line of work which was inaugurated last year, has been continued this year. Three trials, involving the test of 30 watches, have been held during the year, each test lasting 54 days.

Watches are divided by the Bureau into two classes according to the character of the tests, namely, Class A, for watches adjusted to five positions, and Class B, for watches adjusted to three positions. A certificate of performance is issued to all watches passing the test.

The regulations under which the watch tests are conducted, including criteria and tolerances by which the performance of each watch is judged, were issued in the form of a circular during the past year. This circular includes suggestions on the care and handling of watches, a list of the stations sending out time signals, and a list of the boundary points between the various standard time sections.

In addition to the regular test of high-grade watches, the Bureau has commenced an investigation of stop watches, chronograph watches, and timers, for registering short intervals of time, principally for the purpose of determining the suitability of various kinds to the needs of the different branches of the Federal Government. The Bureau is also investigating the relative reliability of cheaper grade of watches for the purpose of obtaining some definite information as to rates of watches having fifteen jewels or less, the degree of isochronism they have, and what is the usual accuracy of their adjustment for isochronism. From these data a definite idea of the relative merits of watches of different grades will be obtained, a point concerning which very little information is available.

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Precision and Empirical Equations.

There has long been felt the need of a simple and definite rule for estimating the precision of the constants of linear empirical equations, since nearly all of the work done by the Bureau in determining the properties of materials and the corrections of measuring instruments falls under this head. The rules afforded by the classical texts on least squares have never come into practical use, because they are enormously complicated and not primarily concerned with the facts the laboratory wants to ascertain. This need has been filled by certain formulas which have been devised and which have proved very useful in the regular work of the Bureau.

Inspecting and Testing Scales.

During the first three months of the last fiscal year 5,000 parcel-post scales for the Post Office Department were inspected at the plant of the Triner Scale & Manufacturing Co., Chicago. On this contract valuable work was done by the Bureau in improving the general design of the scale and the details of its construction and manufacture. These scales were equipped with approximately 175,000 single counterpoise weights, each of which had to be separately inspected and tested for accuracy before acceptance. It was necessary to devise special methods of testing in order to make it possible to test so large a number of weights individually without an inordinate expenditure of time and effort.

During the year a large number of tests were made on new scales and scales in service, on the request of the Post Office and other Federal departments. Especially important was the work of scale testing done for the Navy Department at the various navy yards on the eastern coast, detailed recommendations being furnished that department in relation to the methods to be used in the installation, operation, maintenance, and test of the numerous scales under its jurisdiction. A total of 78 scales other than railroad track scales were tested for this department in connection with the work of the test car.

A number of scales were also tested for the War Department at Fort Hunt, Va., and Fort Washington, Md.

A sample of an automatic scale and one of a hanging spring-dial scale, submitted to the Post Office Department for the parcel-post service by a Chicago contractor, were given a thorough inspection and test with regard to points of design, and numerous recommendations were made relative to making the scales suitable for use in the postal service.

The preliminary study made of the damping of scales resulted in the discovery of considerable useful data relative to the amount of friction which will be met in commercial scales and disclosed valuable information relative to the comparative merits of two different lever systems in the matter of variability and inaccuracy due to friction.

A careful test and inspection were made, and a full report submitted, on a number of samples of stabilized equal arm trip scales submitted by a New York City manufacturer, who submitted these scales to the Bureau with a view to obtaining an opinion on their

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design and construction and receiving suggestions as to the methods which should be employed to improve them.

New drawings were prepared for one of the approved types of 50-pound cast-iron test weights, and of the various forms of approved sealing devices for closing the adjusting cavities of Class C weights.

A paper was prepared on the subject of automatic scales, and read before the Tenth Annual Conference on Weights and Measures. For the purposes of this paper, information was compiled in large amount in relation to the various types of automatic scales on the market, and drawings and literature of every sort were procured and placed on file for reference on this important subject.

In connection with the same paper, a study was made of the cam and pendulum construction used in the more usual types of automatic scales, and useful analytical and graphical methods were devised for the design of the cams used in these scales. This is work of very great importance to the manufacturer and should be developed more fully, as the amount of exact information available to the designer of this apparatus is very meager.

The Bureau acquired during the year a large platform scale of 10,000 pounds capacity, mainly for the purpose of checking its own standards of this denomination, which form a part of the railroad track scale testing equipment of the Bureau. This has temporarily been installed in the engineering shop in order that the crane forming a part of the equipment in that shop might be used to handle the large masses involved. It is doubtful, however, whether the floor of the shop is sufficiently strong to carry the additional weight involved in the test of such large masses, and it is urgently recommended that a special laboratory with a suitable crane and foundation be provided for the test of heavy weights, for which there is an increasing demand. Such a laboratory would also afford facilities now lacking and badly needed for erecting and testing large scales and provide much-needed room for the scale-inspection work of the Bureau.

Operation of Test-Car Equipment.

The equipment for testing railroad track scales, purchased in 1913, has been in continuous service during the year, with the exception of a period of about one month, when it was withdrawn in order to make necessary repairs. Subsequent to the test and standardization of a master scale for the State of Minnesota, in July, 1914, 338 railroad-track scales in the States of Minnesota, Wisconsin, Indiana, Iowa, Missouri, West Virginia, Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, and the District of Columbia; and 78 scales other than railroad-track scales, in the navy yards at Norfolk, Va., Charleston, S. C., Key West, Fla., and Pensacola, Fla., were tested. These scales were located in 86 different cities or towns, and of the track scales 241 were owned by railroads, 89 by manufacturing concerns, and 8 by the Federal Government.

Condition of Track Scales.

Of the 338 track scales tested, 107, or about 32 per cent, passed and 231, or 68 per cent, failed to pass the tolerance adopted by this

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Bureau, which allows a maximum possible error of 200 pounds in weighing a car of 100,000 pounds. The magnitude of the possible errors of weighing a 100,000-pound car were found to vary in commercial scales from 30 pounds to 21,600 pounds.

Reports giving the condition of the scales tested have been rendered to the States which have organized departments of weights and measures. They have also been rendered to the owners of scales when such reports were requested, in which were given the condition of the scale and advice relative to the proper maintenance and repair of the scale. These individual reports, beginning June 1, 1915, were sent to the owners whether they were requested or not. The acknowledgments of these reports show that the work is appreciated and that frequently repairs and new installations follow as a result.

Progress has been made in developing improved methods of testing and adjusting track scales, and considerable work has been done relative to the establishment of a standard method of determining their capacity. Several scales were examined and their capacity determined for State departments, but it was found necessary to limit this work to a very small amount, owing to the smallness of the force.

Specifications were prepared for the use of the National Zoological Park in the purchase of auto truck scales. Some progress has been made in the preparation of railroad-track scale specifications which will be of value to scale manufacturers, purchasers, and users.

An effort has been made to serve as many States and as large a territory as possible with the equipment available, but with 21 States visited to date since October, 1913, it is apparent that more than the present car and the one soon available will be needed in order to carry out even a small part of the work. An additional office force will also be required to handle the results of the track-scale tests and perform the work in the numerous other fields, such as grain weighing, at present awaiting development.

Linear Expansion of Materials.

During the year the range of temperature available for measurements of thermal expansion, electrical resistance, and magnetic permeability in the oil bath regularly used to over 300° C. was extended downward to a temperature of −40° C.

Improvements have been made in the electric furnace used for heating uniformly specimens under test for thermal expansion. Specimens need no longer be limited to the single length of 30 cm. and a diameter of from 5 to 10 mm.; the furnace is now capable of receiving specimens having any multiple of 5 cm. up to 30 cm. in length, and almost any cross section, not necessarily uniform, up to 2 or 3 cm.

The simultaneous measurements of thermal expansion and electrical resistivity, which were commenced a little over a year ago, are progressing favorably and data are gradually accumulating.

An investigation has been started to obtain new data on the thermal expansivity of fused silica (quartz glass) throughout a wide temperature interval, and to compare the expansivities of various specimens prepared under different conditions. There has been acquired by the Bureau a set of 20 specimens, especially prepared for

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this investigation, and representing in duplicate the five types of products, both annealed and unannealed, made by the donor of the specimens. Since fused silica has already become a sort of international standard for thermal expansion, it is important to know the nature and extent of variations in the expansivity of specimens from various sources and subjected to various treatments. It has a wide range of commercial uses, on account of its small expansivity and its resistance to the action of many chemicals. The investigation now in progress is likely to explain why certain types of the product give better results than others.

A study of the expansivity of nickel steel has been commenced for the purpose of assisting American manufacturers in developing methods for producing nickel steels of specified thermal expansivity combined with stability of dimensions and other desirable properties. At the present time practically all nickel steel for scientific purposes is imported from Europe.

Experiments on the expansion of structural steel and the elastic properties and strength of materials at high temperatures have been undertaken in connection with the investigation of fire-resisting materials being conducted by the Bureau. Studies will be carried out on the expansion of specimens selected from different parts of typical steel shapes, in order to determine the change in length on first heating steel beams or columns to high temperatures, and to ascertain whether this expansion is uniform or not throughout the section. These investigations are to obtain data much needed by engineers for designing structures that may be subjected to temperatures above the ordinary atmospheric range.

Annual Conference on Weights and Measures.

The Tenth Annual Conference on Weights and Measures was held May 25–28, 1915, at which there were present 28 delegates representing 18 States, the District of Columbia, and the Philippine Islands; 69 city and county weights and measures officials; and about 80 visitors, representing railroads, manufacturers of weighing and measuring apparatus, trade bodies, etc.

The purpose of the conference is to bring together State and local weights and measures officials to discuss administrative and technical problems which arise in the work. It also serves to point out the great financial saving to the public in having State supervision and local inspection of all weights and measures in commercial use. When it is considered that within the decade that these conferences have been taking place about two-thirds of the States have undertaken this work and vast improvement is reported from practically all sections of the country, it may be presumed that the conference is having marked success in this important economic work.

Tolerances and Specifications.

One of the most important accomplishments of the Annual Conference on Weights and Measures, from an administrative point of view, is the adoption of tolerances and specifications for weights and measures and weighing and measuring devices. The necessity for uniform tolerances and specifications is a pressing need, on account of the vast interstate commerce carried on in the United States, and

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it is believed that those adopted at the last conference will meet this need, which is felt by all weights and measures officials. Heretofore there have been no regulations of this character recognized by the various States.

So-Called Net-Weight Amendment to the Pure-Food Law.

In the amendment of March 3, 1913, to the National Food and Drugs Act of June 30, 1906, provision is made with regard to food in package form for the establishment by rules and regulations of reasonable variations and tolerances, and also exemptions as to small packages. This Bureau is cooperating with the Bureau of Chemistry of the Department of Agriculture in the collection and analysis of data on the weight and methods of packing food put in package form, with a view to establishing tolerances and variations provided for in the law. This investigation has been going on for a number of months and satisfactory progress is being made.

Standard-Barrel Act.

An act establishing a standard barrel was passed by Congress last winter and approved March 4, 1915. This act, known as the "standard-barrel law," fixes a standard barrel for fruits, vegetables, and other dry commodities, and certain subdivisions thereof, and a standard barrel for cranberries. This act refers both to interstate and intrastate transactions and is the first mandatory standard for general commercial use ever established by Congress under the power given to that body by the Constitution "to fix the standard of weights and measures." It is expected that this will be of great help to manufacturers, shippers, commission men, and consumers, since for the first time the term "barrel" will have a definite and certain meaning in the United States. Reasonable variations from the standard are permitted and the Bureau of Standards is empowered to establish tolerances and rules and regulations for the enforcement of the act.

Efforts to obtain uniform weights and measures laws among the States have continued to receive the earnest support of the Bureau, and have met with gratifying success during the past year. Among the States to which assistance was rendered by this Bureau and in which satisfactory legislation was passed may be mentioned Oklahoma, Oregon, West Virginia, Utah, Minnesota, and California.

Information Furnished on Subjects Pertaining to Measures of Length, Mass, Capacity, and Time.

Information concerning screw threads has been furnished in answer to numerous inquiries with regard to the correct figures for, and the use of, various screw-thread systems, wire, and sheet-metal gauges. Among the tests made was one on the determination of the variation in pitch of a screw and the standardization of a bar, both to be used in a comparator for the verification of the accuracy of the standard gauges, limit gauges, etc., made by a well-known manufacturer of machine and mechanical specialties.

The Bureau has kept in touch with the work of the committee on tolerances in screw-thread fits of the American Society of Mechanical Engineers, and was represented at several meetings of the committee.

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There has been an increasing demand for information as to instruments and methods for measuring the humidity of the atmosphere. A large number of letters have been written and a number of psychrometer charts have been prepared and sent out.

As an example of the value of the Bureau's work on the density and thermal expansion of petroleum oils, it may be stated that the rate of expansion of a sample of fuel oil was measured for a railroad company in order to determine whether the temperature correction factor for specific gravity should be 0.0004 or 0.0005 per degree Fahrenheit. It was stated by the railroad company that this difference in expansion meant a gain or a loss to them of between 2,000 and 3,000 barrels of oil per month on a single contract.

Information, specifications, and blue prints for the construction of bench standards for the comparison of steel tapes have been furnished two organizations planning to construct such standards.

The Bureau receives a large number of letters from weights and measures officials throughout the country asking for information and advice concerning their work. It is the aim of the Bureau to assist these officials in every way possible, and to cooperate with them in their work.

Publications on Weights and Measures.

There have been published during the year the report of the Ninth Annual Conference on Weights and Measures; Circular No. 51, Measurement of Time and Test of Timepieces; and Circular No. 47, Units of Weight and Measure.

A paper covering the barometry investigations of the Bureau has been practically completed for publication in the Bulletin of the Bureau. It presents concisely and without experimental details the final and practical results of the various barometry investigations conducted by the Bureau.

2. THERMOMETRY, PYROMETRY, AND HEAT MEASUREMENTS.

Platinum Resistance Thermometers.

The construction of 11 platinum resistance thermometers has been completed. These thermometers, which involved the most painstaking workmanship, are designed for measuring temperatures with the highest attainable accuracy from —200° C. to about 600° C., and when standardized will serve as the instruments for reproducing the standard scale of temperature of the Bureau. The instruments designed for low temperatures are provided with means for drying the air within the thermometers to prevent the condensation of moisture on the coil and leads. The instruments designed for measuring small temperature changes of a few degrees with an accuracy of a few ten-thousandths of a degree, besides being provided with drying heads, are inclosed in closely fitting platinum cases from which the coil is insulated by the thinnest sheet of mica, so that the thermometer coil will follow rapidly varying temperatures with the minimum of lag. This type of thermometer, which was developed by the Bureau and which has been described in Scientific Paper No. 200, is finding extensive use in engineering and research laboratories. The high-temperature thermometers are mounted in externally glazed porcelain tubes. All of the thermometers are con-

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structed so that variable lead resistance can be eliminated, and stray electromotive forces are reduced to a minimum. On account of their high electrical conductivity, resistance to oxidizing influences, and small thermoelectromotive force against platinum and copper, the thermometers are provided with gold lead-wires, with the exception of the calorimetric type, which have the usual flat copper leads to the platinum coil.

A Wheatstone Bridge for Resistance Thermometry.

The highest accuracy attainable in the measurement of small temperature intervals met with in calorimetry with the most carefully standardized thermometers of the mercurial type is of the order of 0°.002 or 0°.003 C. When higher accuracy is required, use must be made of electrical thermometers of the resistance or thermoelectric types, used in connection with a suitable resistance bridge or potentiometer. The present bridge was especially designed for the requirements of the Bureau in calorimetric work of the highest accuracy. Special features are mercury contact links, the use of shunt dials for the 0.0001, 0.001, and 0.01 ohm decades, a new form of hermetically sealed coil, and complete oil immersion of contacts as well as coils in order to reduce disturbing thermoelectromotive forces. Measurements by the Thomson double-bridge method are also provided for. A complete description of this bridge has been published in Scientific Paper No. 241.

As a result of the experience gained with the use of this apparatus, a simplified type of bridge adapted to resistance thermometry has been designed and constructed and has been in use for a year or more. This will be described in a future number of the Bulletin of the Bureau.

A Multiple Junction Thermoelectric Thermometer.

A multiple junction thermocouple, made by the Geophysical Laboratory and kindly loaned to the Bureau, was standardized by comparison with a platinum resistance thermometer to an accuracy of 0°.001 or 0°.002 in the range 0° to 50° C. This multiple thermocouple has been used by the above laboratory to standardize a number of their couples and it thus serves to define the temperature scale for the precision work of that laboratory in the range 0° to 50° C.

The Emergent Stem Correction for Thermometers in Creosote Oil Distillation Flasks.

Thermometers used in distillation flasks are subject to error if a portion of the thermometer stem, containing the mercury column, is emergent from the flask and is at a temperature different from that of the bulb.

This emergent stem correction error is discussed with particular reference to creosote oil distillation. Emergent stem corrections were determined, applicable to a particular type of thermometer when used in four types of distillation flasks.

The average correction found for the ordinary side-neck distillation flask at 200° C. was 4°.5; at 250°, 6°.0; at 300°, 10°.5; and at 350°, 15°.5, with differences of as much as a degree between the same

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readings on different runs, making it evident that the average corrections could not be relied upon to better than a degree. For the same temperature, using the same thermometer in different flasks, the greatest difference in the stem corrections found was 2° C.

Reasons for variations in emergent stem corrections for different runs on the same flask are discussed. The greatest errors are caused by the use of unsuitable thermometers and variations in the rate of rise of temperature. The most suitable thermometer for distillation flasks seems to be a continuous-scale graduated stem type of mercurial thermometer having a length of about 40 cm.

The effect of radiation and condensed vapor on the temperature measurement is discussed.

The magnitude of the disagreement in distillation results when in one case allowance is made for stem correction and in another case it is not, is shown by example.

A method was suggested by which the total correction (including scale correction and emergent stem correction) to a thermometer used in distillation flasks can be determined at two points by reading the thermometer first in the vapor of boiling naphthalene (temperature 218° C.) and then in the vapor of boiling anthracene (temperature 340° C.). Interpolations for the corrections between these two points can then be made. This method was investigated and found to be reliable to 1° or 2°. This investigation has been published under the above title in Technologic Paper No. 49.

Low-Temperature Thermometer Comparator.

A low-temperature comparator was designed and built. It consists of a large cylindrical Dewar flask containing a suitable liquid (gasoline or pentane) and is provided with a motor-driven stirrer. Cooling to —50° C. is effected by expanding (through a sensitive valve and an immersed coil) carbon dioxide obtained from the CO_2 compression system maintained at the Bureau. Below —50° C. liquid air supplied through a siphon in the required quantity is used and temperatures down to —150° may be obtained. An electric heating coil in the bath is used to aid in temperature regulation. An investigation of the temperature distribution in the bath has shown that at —50° the temperature over a length of about 25 cm. is uniform to 0°.01 or 0°.2 C.

Specifications for Laboratory Standard Thermometers.

Some time has been given to the preparation of specifications for high-grade laboratory thermometers of a type suitable for working standards in the laboratories of the Bureau and in other scientific and technical laboratories. After the thermometers made up in accordance with these specifications have been thoroughly tried out and the specifications have been finally revised in the light of the experience resulting therefrom, it is planned to publish a circular on specifications for laboratory standard thermometers. Such a circular would answer numerous inquiries addressed to the Bureau on this subject and would be of great service to many scientific and technical laboratories in furnishing information as to the equipment of the laboratory with reliable working standards.

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Recording Deep-Sea Thermometer.

At the request of one of the Government bureaus, designs were prepared for a deep-sea thermometer which would give a continuous record of deep-sea temperatures with an accuracy much greater than is attainable with the ordinary reversing type of mercurial thermometer, an accuracy of 0°.01 being desired. The principle adopted is similar to that of the mercurial thermostat, except that the platinum contact point is movable. This contact point, mounted on the lower end of a steel rod (0.5 mm.), is driven downward through the bore of the capillary by clockwork mechanism until the platinum point comes into contact with the mercury meniscus, when an electric circuit is closed, the rod lifted upward a short distance, after which it again proceeds downward as before. The upper end of the rod carries a point which marks a continuous line on a roll of paraffined paper, a scale being simultaneously recorded by similar means. The whole mechanism is inclosed in a steel cylinder (40 cm. high by 12 cm. diameter) capable of resisting deep-sea pressures.

An opportunity has not yet been found for constructing and trying out this design.

Other Thermometric Investigations.

Owing to the very great demands on the thermometric section for testing, it has been possible to give but little time to several investigations that have an important bearing on the work of this section.

There has been a considerable demand both from other laboratories of the Bureau and from outside laboratories for thermocouples standardized at very low temperatures (—200° C.). A stock of special wires for this purpose was purchased some time ago and it would be of great advantage to the Bureau to standardize these wires so that they could be issued for use for low-temperature measurements. It is hoped that the necessary assistance can be given to this section so that the important work of establishing the low-temperature scale can be taken up and completed in the near future.

Some progress is reported on the following investigations:

The standardization of the specially designed and constructed platinum resistance thermometers described in the earlier sections of this report.

The determination of the "ice-point depressions" of different thermometric glasses after heating and of the rate of recovery of the same.

The standardization of a complete set of mercurial thermometers for use as working standards in the interval —40° to 500° C. The completion of this investigation is essential to the work of testing.

Characteristics of Radiation Pyrometers.

Radiation pyrometers are instruments in which the measurement of the temperature of a body is based on the measurement of the intensity of the radiation (both light and heat) emitted by that body. The object of these present investigations has been twofold—(1) to assist the pyrometer manufacturer in producing a more reliable and satisfactory instrument and (2) to call attention to the possibilities of the instrument, and the precautions which must be understood by technical and scientific men who employ this method of temperature

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measurement. Full details of this investigation have been published in Scientific Paper No. 250. The paper treats in detail the following subjects:

1. General principles of radiation pyrometry, fundamental equations, and mechanical requirements which must be considered in the construction of the instrument.

2. Types of radiation pyrometers. The construction of the various pyrometers available is discussed, and the principles upon which many of the working parts operate are considered.

3. Methods of calibration. Two methods are given, one a primary method in which the calibration is obtained by sighting the pyrometer into an opening in a uniformly heated inclosure, known as a "black body," the temperature of which can be measured by thermocouples. The other method is a secondary method which may be used to calibrate other pyrometers by comparison with a standard pyrometer calibrated by the first method.

4. Method of use. Under this heading are considered methods of obtaining the reading of the pyrometer, extrapolation of the temperature scale to higher temperatures than those at which a calibration can be made, methods of automatically recording which permit a continuous automatically printed record of the temperature of a furnace during a prolonged run, as well as a check upon the operators of the furnace. These records are very valuable in the technical industries. Radiation pyrometers in general require a rather large source upon which the pyrometer is sighted. Methods are given for obtaining the correct temperature when the source is of insufficient size to meet this requirement.

5. Discussion of errors. The elimination of the errors in measurements with radiation pyrometers is of great importance. These errors are considered in detail for every type of instrument. If the precautions given are strictly followed, the temperature measurements can be relied upon. If these precautions are not followed, errors may be involved of such magnitude that in general the readings of the instrument will be of no value whatever.

6. Applications. The use of the radiation pyrometer for the study of the radiating properties of glowing materials is considered, and data are given for correcting the readings of radiation pyrometers, sighted upon several metals and oxides in the open, to true temperatures.

Radiating Properties of Metals and Oxides.

An important factor in recent metallurgical progress in the development of special alloys is the better control of temperatures that is now possible.

In many of these processes the temperature must be measured by optical or radiation pyrometers. These pyrometers read incorrectly when sighted upon glowing metals in the open. It has been the purpose of this investigation to determine the corrections necessary to apply to the pyrometer readings to obtain the correct temperature of the material sighted upon. The investigation of nickel oxide was reported last year. The paper has since been published as Scientific Paper No. 224. Partly from the purely scientific interest, the radiation of platinum has been studied and a theory has been

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developed connecting the total radiation with the resistance and temperature of a metal. This work was published in Scientific Paper No. 243. The fourth number in this series, Scientific Paper No. 249, is an investigation of the radiometric properties of iron oxide. Corrections are given which permit the measurement of the true temperature of a steel rail; for example, as it passes through the rolls. The temperature gradient through the layer of oxide formed upon glowing iron in the open air was also measured. The outside oxide layer on a glowing iron rail may be 100° cooler than the iron immediately under the oxide.

In the coming year these investigations will be extended to other metals and oxides.

Other Investigations Relating to Pyrometry.

Some time has been given to the preparation of papers on "The Center of Gravity and the Effective Wave Length of Transmission of Pyrometer Color Screens" and on "A New Relation Derived from Planck's Law," which will be completed and submitted for publication early in the next fiscal year.

Methods of Testing Refractory Materials.

The Bureau is cooperating with the American Society for Testing Materials in a study of the methods of testing materials used to withstand high temperatures. Methods of determining the following properties are being studied: Melting point; chemical composition; thermal conductivity; thermal expansion; porosity; permanent volume change; crushing strength at ordinary and at high temperatures; resistance to abrasion; resistance to spalling; resistance to slagging action.

Any experimental work that may be required will be done in one or the other of the laboratories of the Bureau equipped for the work in question.

Standard Heat Samples.

In the last annual report was described the determination of the heats of combustion of specially purified samples of cane sugar, benzoic acid, and naphthalene. This work has since been published in Scientific Paper No. 230. Samples of these substances are now regularly sent out by the Bureau as standard heat samples and are widely used by chemists and engineers for the standardization of the calorimeters used for testing the heat values of fuels, foods, etc. Two hundred and fifty-three of these standard heat samples were furnished during the year to numerous industrial plants using large supplies of fuel, such as cement, steel, cotton, and paper mills; coal, oil, and gas companies; electric power companies; and chemical manufacturing plants; as well as to university, technical, municipal, State, and National testing laboratories and bureaus.

As time permitted, determinations have been made of the heats of combustion of other substances, such as hippuric acid, anthracene, camphor, phthalic acid, pthalic anhydride, and salicylic acid. The samples on which these determinations were made were prepared several years ago. The determinations should be repeated on more recently purified samples before the results are ready for publication.

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Another calorimeter jacket, very similar to that used in the investigation above referred to, has been constructed by the instrument shops of the Bureau, and detailed working drawings have been furnished to a manufacturer who contemplates putting it on the market so that it will be available to laboratories requiring the highest accuracy in calorimetric measurements.

A new edition has been issued of Circular No. 11, entitled "The Standardization of Bomb Calorimeters." This circular contains more complete information on the use of the standard heat samples for the standardization of bomb calorimeters than was contained in the previous edition. The most important feature of the circular, however, is the change in the standard heat unit of the Bureau, effective July 1, 1915, to which change attention is directed. After careful consideration the Bureau has decided to adopt as the fundamental unit of heat the calorie, expressed in terms of the capacity for heat of water at 20° C., instead of at 15° C., as heretofore.

Gas Calorimetry.

The publication of Technologic Paper No. 36, on "Industrial Gas Calorimetry," and of Circular No. 48, on "Standard Methods of Gas Testing," both of which were reviewed in last year's report, has resulted in greatly increasing the demands on the Bureau for the testing of gas calorimeters, the work in this section being several months in arrears.

A member of this division together with a member of the chemical division were called on as referees to investigate the differences in the results of heating value tests found in a large eastern city by the engineers of the State public-service commission and by the engineers of the public utility supplying the gas.

An investigation that has been carried forward from year to year is one relating to the determination of the heating value of the more important elementary gases that enter into the composition of natural and manufactured gases. Some progress can be reported this year by the chemical division in the preparation of very pure hydrogen for this work and by this division in a number of determinations of the heat of combustion of samples of this hydrogen. It is to be hoped that the necessary assistance can be given to this section to take care of the increasing demands for testing, so that greater progress will be possible on this important investigation.

An Aneroid Calorimeter.

For the measurement of specific heats and latent heats of substances under pressure (for example, anhydrous ammonia, carbon dioxide, etc.) and for other purposes outside of the range of application of the familiar form of liquid calorimeter, there was developed a calorimeter which utilizes for equalization of temperature the thermal conductivity of a solid copper shell in connection with a built-in heating coil and a built-in platinum resistance thermometer. Details of the design, construction, and operation are described in Scientific Paper No. 247. Results of the standardization of the instrument are given, and also, as the results of a test of its performance, a few experimental determinations of the specific heat of water in the interval from 0° C. to +40° C. The precision attained was

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such as to indicate an entirely satisfactory performance of the calorimeter. The results of these determinations are in fair agreement with the mean of a number of the more reliable measurements in recent years, but must not be considered as an authoritative measurement by the Bureau of this very important quantity.

Specific Heat and Heat of Fusion of Ice.

As a part of the program outlined later under the title "Refrigeration constants" there were completed a series of experimental determinations of the specific heat of ice in the temperature range from —40° to 0° C. and of the heat of fusion of ice. The measurements were made by means of the calorimeter of aneroid type described above.

The specific heat of four samples of ice, all of high but of different degrees of purity, was determined. By analysis of the results the conclusion drawn is that (s) the specific heat of pure ice, may be represented between —40° and —2° by the equation $s=0.505_7+0.00186_3\theta$, the unit being the 20° calorie, and θ being the centigrade temperature. Between —2° and —0°.05 the specific heat does not exceed the value given by this equation by more than $0.004/\theta^2$. The specific heat of impure ice, within the same temperature interval, was found to be greater than that of pure ice by an amount $80\ 1/\theta^2$, where 1 is the (centigrade) freezing temperature of the ice. The value found for the latent heat of fusion of ice is 79.76 20° calories per gram, which is within 1 part in 4,000 of the value determined last year by an entirely different method. The results are communicated in Scientific Paper No. 248.

Heat Capacity of Water and the Mechanical Equivalent of Heat.

No progress has been possible on this investigation during the past year.

This investigation is of fundamental importance in fixing the primary unit of heat. In the half dozen or more extended pieces of work that have been published on this subject, which may be said to be more or less generally accepted, there appear startling discrepancies, and it is evident that this fundamental measurement has not been made with anything like the degree of accuracy which modern calorimetric practice demands. In the course of the calorimetric researches that have been under way in the laboratories of the Bureau during the past several years, a great deal of valuable data have been obtained on the capacity for heat of water. The work has suggested improvements in apparatus and in methods of experimentation which will be tried out as soon as opportunity permits. In view of the importance of the work and of the discrepancies in existing data, it is deemed best to withhold publication until the work has been carried out with the highest accuracy that can be obtained by the best modern methods.

Control of Atmospheric Humidity in Laboratory Rooms.

In many technical and scientific laboratories the effects of atmospheric humidity are such that it becomes of importance to maintain constant conditions not alone as to temperature but as to

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humidity as well. Examples of such laboratories are certain customs and textile laboratories and electrical laboratories. This division has been cooperating with some of the other divisions in a study of feasible methods of controlling atmospheric humidities in laboratory rooms.

Constant Temperature Room.

One of the laboratory rooms was rebuilt during the year as a special constant temperature room for the thermal conductivity measurements. The walls were well insulated and a special cooling and heating system with automatic control installed, so as to maintain any temperature from that of freezing water to as hot as an observer working in the room can stand. The room was designed especially for service tests of pipe coverings, which series of tests can be started as soon as observers may be available to assign to it.

Thermal Conductivities of Insulation and Building Materials.

This work has been undertaken at the request of the railway companies in connection with insulation requirements of steel passenger-car construction, and the Railway-Mail Division of the Post Office Department, in connection with insulation specifications for steel postal cars; the manufacturers of building insulation materials, steam and brine pipe coverings, etc.; the furnace construction industry; and the furniture construction and refrigeration industries, in connection with the construction of cold rooms and refrigerators. Thermal conductivity data are also of importance in connection with building construction in its bearing on the heating of buildings, the resistance of walls, floors, etc., to the flow of heat and transmission of fires, the effectiveness of fireproof coverings of columns, girders, etc.

Notwithstanding the fact that thousands of thermal conductivity measurements have been made in many different laboratories, the results are extremely unsatisfactory, showing wide discrepancies. The need of standardization is obvious, but the problem presents unusual difficulties and the progress of the investigation is necessarily slow.

A piece of trial apparatus, taking samples in the form of slabs about 8 inches square, has been in satisfactory service for some months, and a similar apparatus for much larger samples has been constructed and used to some extent. Preliminary reports of the work have been submitted for criticism and consultation to the manufacturers who furnished samples. Especial attention is being given to the investigation of the factors which determine the insulating properties of an air space, such as thickness of air layer, distance between baffle plates to break convection streams, etc. A proper understanding of these factors will have an important bearing on the cellular wall construction of cold rooms, refrigerator cars, and car insulation in general.

Some time has been given to the design of an apparatus adapted to the determination of the thermal conductivities of materials up to temperatures corresponding to red heat, as well as at ordinary temperatures.

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Temperature Conductivity of Cotton Bales.

For the purpose of determining the feasibility of destroying by heat a particular boll weevil found to be present in bales of imported Egyptian cotton, the Bureau of Entomology of the Department of Agriculture requested this Bureau to determine the time required to bring all points in the interior of a bale of cotton to a certain minimum temperature, when the exterior was maintained at a higher known temperature.

To this end copper-constantan thermocouples were placed, with considerable difficulty and labor, at various points in the interior of the bale, the bale placed in a specially thermostated constant temperature room maintained at approximately 150° F., and readings taken hourly, both day and night, for about one week, on the thermocouples in the interior of the bale, until they all reached a temperature somewhat in excess of 120° F., which was the temperature supposed to be necessary to destroy the boll weevil. A complete report of the results of this test was submitted to the above-mentioned bureau.

Tests of Household Refrigerators.

A comprehensive test of commercial refrigerators was carried out for the War Department as a basis for the award of a contract. These tests related to ice consumption, temperature distribution, and air circulation within the refrigerators. As a result of the data obtained in these tests, the Bureau is endeavoring to cooperate with manufacturers in the direction of improvement of this product. Parts of this test of refrigerators are necessarily confidential, but the parts that can be made public are summarized in a popular manner in Circular No. 55, "Measurements for the Household."

It is hoped that an opportunity will be found to make more extensive tests along these lines, especially on the cheaper grades of refrigerators in common use in the household. Deficient insulation may result in unnecessary expenses and waste, and very often it would be possible for the manufacturer to very materially increase the efficiency of his refrigerator without any very significant increase in cost. Inefficiency is probably as often due to lack of knowledge of the important features of the design, of physical properties of materials used, etc., as it is to an attempt to cheapen manufacturing costs.

Liquid-Air Plant.

The liquid-air plant has supplied liquid air to the several divisions of the Bureau as it has been required by the researches and tests in progress. On several occasions liquid air has been furnished for lectures before teachers' organizations. The carbon dioxide compressor has been operated almost continuously throughout the year to operate low-temperature baths required by the investigation of refrigeration constants and by the thermometer laboratories.

Three new liquefiers have been constructed and tried out. One of these has a capacity, when used with brine precooling, of about 6 liters of liquid air per hour.

A new electrolytic oxygen and hydrogen gas generator has been installed for furnishing these gases to the chemical laboratories.

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Industrial Viscosimetry.

The most important laboratory test of the lubricating value of an oil for the purpose in view is the viscosity test. The instruments most widely used by the oil industries in the specifications of the viscosities of lubricating oils, in domestic and foreign commerce, are the Saybolt-Universal, the Engler, and the Redwood viscosimeters. At the request of the American Society for Testing Materials and of many industrial oil chemists, the Bureau undertook an intercomparison of these instruments and recently submitted a report of this work to the above-mentioned society. This report contains suitable conversion tables so that results found with any one type of these instruments can at once be converted to the scale of either of the other two types.

The Bureau is constantly receiving requests from technical men for information on the measurement of the viscosity of lubricating oils. Nearly fifty long letters and reports were prepared during the year in reply to such requests. More assistance is needed for this work, which at present is carried as a side line by one whose time is otherwise more than fully occupied. Important work that has been deferred from year to year is the preparation of a circular on industrial viscosimetry which would serve to answer numerous inquiries such as are referred to above. The Bureau is constantly in receipt of requests for standard viscosity samples, which would enable oil chemists to standardize and check from time to time their viscosimeters, in the same way that they now can check their heating value tests by means of the standard heat samples furnished by the Bureau. This work can be placed on a most satisfactory basis as soon as an assistant can be assigned to it.

Standardization of Flash-Point Testers.

One of the important tests of an oil to determine its safety in use and its suitability for particular applications as well as for compliance with specifications is the determination of its flash point; that is, the temperature at which it gives off volatile vapors that will ignite explosively if brought into contact with a flame or object at high temperature. This flash point is dependent not alone upon the chemical constitution of the oil, but is very materially influenced by many other factors, such as whether the cup is open or closed, the form and dimensions of the apparatus, the point of application of the flame, the size of the latter and time of its application, the protection against air draughts, the height of the oil in the cup, the degree of stirring of the oil, the method of taking the temperature of the oil, the rate of heating the oil as the flash point is approached, the barometric pressure, and many details of manipulation. Hence, it is of importance to investigate the effect of these various factors to enable the test to be standardized.

The Bureau has undertaken the standardization of the flash-point testers of the Abel-Pensky and of the Pensky-Martens types as modified by the Bureau of Mines. Four of these instruments were submitted for test in March, 1915, and a considerable amount of experimental work was done with them. As a result of this work certain modifications were proposed and are now under consideration by the Bureau of Mines. Arrangements have also been made to

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cooperate with that bureau on the preparation of the necessary standardization specifications and of the operating directions.

Refrigeration Constants.

This very extensive investigation, undertaken at the request of American refrigeration engineers expressed through their national associations, includes the determination of the fundamental constants of refrigeration engineering.

The work is being carried out with the cooperation of committees of the American Association of Refrigeration and the American Society of Refrigerating Engineers, the members of which visit the Bureau annually, keep in close touch with the work, and have rendered valuable assistance by practical suggestions. The program is as follows:

(*a*) The latent heat of fusion of ice.

(*b*) The specific heat of ice, —50° to the melting point.

(*c*) The specific and the latent heats of common refrigerants, such as ammonia, aqueous ammonia solutions, carbon dioxide, and ethyl chloride.

(*d*) The specific and the latent heats of the vapors of the common refrigerants.

(*e*) The densities or specific volumes of the saturated vapors and of the liquids commonly used as refrigerants.

(*f*) The vapor pressure-temperature relations of the substances commonly used as refrigerants.

(*g*) The density-concentration relation for aqueous ammonia solutions.

(*h*) The vapor pressure-concentration relation for aqueous ammonia solutions.

(*i*) The specific heats of brines.

(*j*) The density-concentration-temperature relations of brines.

(*k*) The thermal conductivities of insulating materials used in cold-storage construction.

(*l*) Certain works problems, the solution of which seem to require the facilities of this Bureau.

The investigation involved the original design and the construction in the instrument shops of the Bureau of a large number of accurate and complicated pieces of apparatus. These have been remodeled as the experience gained in their use dictated, and the actual measurements made with them have progressed as follows:

The measurements upon ice have been entirely completed and published (*a*) in Scientific Paper No. 209, reviewed in last year's annual report, and (*b*) in Scientific Paper No. 248, reviewed in an earlier paragraph of this report. The results of this latter were communicated to the American Society of Refrigerating Engineers at their annual meeting in December, 1914, and are incorporated in the Transactions of that society.

The measurements upon ammonia received the principal attention during the latter part of the year, and some of the results should be ready for publication early in the coming year. In particular, the measurements (*c*) of latent heat and specific heat of this substance are well advanced.

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The thermal conductivities of insulating materials used in cold-storage construction are being determined in connection with similar measurements upon materials used for insulation in other ways, an investigation which is the subject of a special paragraph elsewhere in this report.

Among the works problems which called for investigation by the Bureau that of the presence of noncondensible gas in ammonia refrigeration systems received considerable attention. A preliminary report upon this subject was included in last year's annual report.

The Fire-Resisting Properties of Structural Materials.

The object of the investigations on the fire-resisting properties of structural materials is to furnish to architects, construction engineers, builders, State and city building bureaus, insurance interests, and others fundamental engineering data relating to the behavior and safety of various types of building material and construction when exposed to different conditions met with in fires.

The wide scope of these investigations requires the close cooperation of many of the laboratories of the Bureau. Thus at present the heat, weights and measures, electrical, concrete, ceramics, and structural materials laboratories are engaged on various phases of this work, such as the measurement of high temperatures, the design and construction of large furnaces for testing building panels and partitions, the fire tests of partitions built up of different structural materials, the determination of thermal conductivities and expansions of various structural materials, safety rules for electric wiring and problems appertaining to the national electrical code, etc., and the load-carrying capacities of structural steel columns under exposure to fire conditions when unprotected, partially protected, and fully protected by fireproofing coverings of different materials applied in various thicknesses and in the various ways commonly used in building construction.

This work serves as an excellent illustration of the broad scope of an engineering investigation that requires the cooperation of a number of the scientific and engineering laboratories of the Bureau.

Fire Tests of Building Columns.

Many millions of dollars are annually spent on the construction of buildings, the integrity of which, in the event of fire, is dependent on the behavior of the steel columns supporting the structures. Very little engineering data are available which would permit of any certain conclusions as to the thickness and kind of fireproof covering required to render these columns safe under various conditions of fire hazard. The requirements of city building codes on these questions are so different that it is evident that some codes are either requiring an unnecessarily thick fireproof covering, with undue increase in construction costs, or else other codes are requiring too thin coverings, with undue increase in danger to the stability of the structure under the existing fire hazards.

The fire tests on building columns are being carried out jointly with the Underwriters' Laboratories, of Chicago; the Mutual Laboratories, of Boston; and the Bureau of Standards. In the first series of tests are included over 70 structural-steel, reinforced con-

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crete, and cast-iron columns. The columns will be tested in a specially designed furnace now nearing completion in the Underwriters' Laboratories in Chicago. The columns to be tested are designed for a working load of 50 tons. Each column will be placed in the furnace, a constant follow-up load of 50 tons applied by a hydraulic machine, and the column heated until it fails. The temperature in the furnace and in various parts of the column will be measured by suitable thermocouples; and the amount of deformation produced in the column during the test will be measured by means of a suitable apparatus which has been especially designed for this purpose.

The steel columns are of various types commonly used in building construction, such as rolled H, plate and angle, plate and channel, latticed channel, etc. Some of the columns will be tested unprotected, some partially protected, and others fully protected. The protective coverings are concrete, plaster on metal lath, clay tile, and gypsum tile. The protective coverings will be made from representative materials obtained from different parts of the United States.

Much of the necessary preliminary work of this large program of column tests has been done. It is expected that the protective coatings will be applied during the coming autumn and winter and that the actual fire tests will begin in the spring of 1916.

Thermal Efficiencies of Column Coverings.

Tests are under way at the Pittsburgh laboratories of the Bureau on the rate of temperature rise within cylindrical specimens of the various materials used for fireproofing building columns, with a view to supplementing and checking the results of the column tests. A special gas-heating furnace has been built for this work and a large number of cylinders of different materials have been prepared with suitable provision for inserting thermocouples axially, with their junctions at different distances from the heated cylindrical surface. Cylinders similar to the cylinder under test are placed at each end of the latter, in contact with its end faces, to minimize the disturbing effects of heat losses from the ends.

Strength of Steel at High Temperatures.

As a preliminary to the tests of the building columns, some tests were made upon steel tubes to determine the relation between the load they will support and the temperature to which they are heated. The ultimate compressive strength was measured by mounting the tubes in a testing machine, the tubes being heated quite uniformly by a suitably spaced electric heating coil wound over the outside and loss of heat from the ends being reduced to a minimum by asbestos disks. The temperature was measured by a thermocouple within the tube extending some distance beyond the center and then doubled back on itself to minimize the effects of conduction to the cooler ends. The behavior of such a tube may be expected to simulate closely that of a steel column. The tests were made primarily to obtain information as to what is to be expected in the much more elaborate tests of actual columns, and to serve as a guide in the design of the apparatus for those tests, especially the apparatus for measuring the temperatures of the columns. The results of these preliminary experiments seem to show that the protective covering on

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a steel column, to be effective in a fire, must prevent the steel from reaching a temperature in excess of about 625° C. (1,150° F.).

More elaborate tests on small building columns are to be made in a special furnace built for such tests at the Pittsburgh laboratories of the Bureau.

Thermal Expansion of Structural Materials.

The weights and measures division has completed the designs for an oil bath and for an electric furnace which provide facilities for the determination of coefficients of expansion in the temperature range from that of liquid air (about —190° C.) up to about 700° C. The construction of these rather elaborate pieces of apparatus has been completed in the instrument shops of the Bureau and will be applied, as time permits, to the determination of the coefficients of expansion of structural steels, the samples to be tested being taken from different parts of the sections of large building columns and girders of known composition and elastic properties.

Panel-Testing Furnace.

During the latter part of the fiscal year the erection of a panel-testing furnace was begun, which will afford the best modern facilities for testing the fire-resisting properties of building partitions, the test panel being 12 by 16 feet in area. The equipment provided consists of an oil-burning furnace, with necessary boiler, blower, oil tank, etc., 5 massive structural steel frames into which the test panels are built, suitable trolleys, crane, structural steel panel rack, etc., to enable the built-in panels to be moved into position before the furnace, fire pump for applying the hose stream from a 1⅛-inch nozzle on the heated partition under test, to simulate fire conditions, etc. This plant, when fully equipped with 7 additional panel frames, will cost about $15,000 and will be the most complete of its kind at present available. It is expected that fire tests can be started early in the coming winter. Steps will be taken to formulate a comprehensive program of fire tests of various building materials after consultation with representatives of the various engineering and technical societies and manufacturing associations interested in the manufacture and use of these materials.

Building Codes.

The engineering data resulting from investigations such as those above referred to must serve as the foundation upon which building codes must be constructed. Some progress has been made during the year in compiling the municipal building codes, not alone with a view to furnishing information to State and city building bureaus and to others interested along these lines, but with a view to a comparative study of existing codes to assist in planning a systematic program of investigations to definitely answer the many important questions about which there are still great differences of opinion.

Recommendations Concerning Fire-Resistance Investigations.

In the several preceding paragraphs there has been given a brief summary of the work of the Bureau relating to the investigations of the fire-resisting properties of structural materials. The data sup-

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plied by such tests, however elaborate and comprehensive they may be, will only be utilized to their fullest advantage after they have been considered by all the numerous interests concerned and have been finally incorporated into State and municipal building codes. The goal toward which this work should tend, therefore, is to supply the necessary engineering data on which to base a much-needed revision of our building codes. With the appropriations at present available it is possible to undertake investigations on only a few of the important features of building construction. Hence, as shown by the foregoing summary, the present activities of the Bureau along these lines are concentrated on the tests of building columns and of building partitions. Many other important features of building construction should be made the subject of systematic investigations, such as floors, roofing, fire doors and shutters, and wired glass. To install a satisfactory equipment for testing floors under conditions of load and fire will require about as much more. Upon the completion of the panel-testing furnace now being installed, the Bureau will have a very complete plant that should be operated continuously during the next few years in order to obtain the necessary data on the many different materials entering into building construction. This work is necessarily expensive, as it involves the testing to destruction of full-sized specimens. With the present appropriation only occasional tests can be made and the present equipment, therefore, only very inefficiently utilized.

Not all of the equipment referred to above should be immediately provided. It is of great importance that one or more of the more important items be provided each year in order that the several lines of investigation can be carried along together, thus rendering possible the accumulation of the necessary engineering data to warrant a revision of our building codes within a reasonable time, say the next five or six years.

Along with the investigations referred to, a number of subsidiary investigations having an important bearing on building construction should be carried out, such as sprinkler systems, storage of inflammables, and temperature actually attained in various types of fires from field inspections and special laboratory tests.

In the last few years many public organizations have become active in a nation-wide campaign to reduce the present annual fire losses of a quarter of a billion dollars. The Bureau should do its part to assist in this great movement for national conservation.

To provide for the immediate requirements of this work, namely, the installation of the necessary facilities for beginning the fire tests on floors, fire doors, roofs, etc., and for the continuous and efficient operation of the large panel-testing furnace now nearing completion, it is recommended that the appropriation for this work be increased to $50,000 a year.

Fire Tests of Insulated Sheet-Metal Cabinets.

At the request of the General Supply Committee, the Bureau made a number of fire tests on insulated sheet-metal cabinets of the type that had been submitted to that committee for the award of contract for the ensuing year. The cabinets tested were 7 in number, the product of six different manufacturers, and were purchased on the open

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market. The dimensions of the cabinets varied somewhat, but were about 6 feet by 3 feet by 2 feet.

The test was made by mounting the cabinet within a large gas furnace in such a way that the cabinet was exposed to the flames on all sides. Thermocuples mounted on the outside of the cabinet, but near its outer walls, and in the interior space of the cabinet, served to measure the temperatures. Paper and small pieces of wood were also placed on the shelves within the cabinet. The temperature, as recorded by the thermocuples in the furnace, was raised quite rapidly to 1,500° to 1,700° F. A temperature of 400° F., which is sufficient to seriously damage contained documents, was reached in the various cabinets in from 5 to 23 minutes after starting the fire in the furnace. After the tests the cabinets were taken apart and examined for details of construction, insulation, damage to contents, operation of doors, etc. A detailed report of the tests was sent to the General Supply Committee.

While one of the conditions of these tests, namely, exposure to fire on all six sides, was more severe than would be likely to prevail in an actual fire, this fact would not materially influence the relative rating of the several cabinets and it would not affect the conclusion that these cabinets do not afford sufficient protection to contained documents when they are used where the fire hazards are even moderately severe. In fireproof buildings, with steel furniture, and little combustible matter to support a fire, their use would be perfectly safe, but in buildings having wooden floors, furniture, etc., and sufficient combustible matter to support even a moderate fire for half an hour or so, most of these cabinets would not afford sufficient protection to contained documents.

In view of the fact that some of the cabinets included in these tests are extensively advertised by the makers as safe under the most severe fire conditions, and even as being approved by the Government, it seems probable that at least a part of the public may be misled into a false sense of security in using some makes of cabinets for the storage of valuable documents.

An examination of the cabinets after they were taken apart showed that in most cases there was only a thin layer of insulating material between the inner and outer sheet-metal walls, a thick layer of air being depended upon for thermal insulation. The construction of these cabinets seems to indicate that there is a very general misunderstanding as to the insulating properties of an air space. While it is true that the thermal conductivity of quiescent air is very low, yet under the conditions prevailing in these cabinets when exposed to high temperatures there is a very large amount of heat transmitted through an unobstructed layer of air by convective circulation of the air and by radiation through the air. The amount of heat thus transmitted can be very much reduced by a suitable insulating material.

In view of the very unsatisfactory conditions found as a result of these tests, a report was sent to each manufacturer whose product was included in these tests, giving in detail the results of the tests of his product and containing suggestions for improvement. The Bureau has since received communications from a number of manufacturers stating that a much-improved product had been developed and requesting that the Bureau make further tests along the same

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lines, a request which it is hoped can be met if the present crowded schedule of work will permit.

Melting Point of Concrete.

The melting point of 11 samples of concrete that had been through the Edison fire was determined with a view to ascertaining the temperatures that had been attained in this fire, some of the concrete in this fire being in a condition which showed evidence of softening and flow.

Observations in Connection with the International Ice Patrol of 1915.

In connection with the International Ice Patrol of the U. S. Coast Guard cutter *Seneca*, the Bureau was represented on all the cruises of that vessel by one observer and on one of the cruises by two observers. Practically continuous records were obtained of the temperatures of the sea water, including a rather detailed study of the temperatures of the currents off the Banks of Newfoundland and vicinity, with frequent determinations of the densities of the sea water, current measurements on the tail of the Great Bank, and some further observations on the temperature variations of sea water in the immediate vicinity of icebergs. Work done on atmospheric nucleation with respect to the formation of fog, including measurements of corona and of total liquid contents of fogs, is described in another section of this report.

Testing of Heat and Thermometric Apparatus.

During the year 1,300 mercurial thermometers of various kinds were submitted for test, of which 1,190 were certified. Among those submitted, there were 278 ordinary calorimetric thermometers, 78 precision calorimetric thermometers, 17 clinical standards, and the remainder laboratory and special thermometers of various types and ranges from below 0° to 500° C., including 5 recording thermometers. About 1.8 per cent were received broken and about 2.7 per cent were broken in the course of testing.

Sixteen thousand five hundred and twenty-four clinical thermometers were submitted for test; of this number 14,929, or 90.4 per cent, were certified. The percentage of those rejected amounted to 9.6 per cent of the total number submitted; 0.8 per cent were rejected on account of defects in construction, 1.1 per cent because of too great difficulty in throwing back index, 0.4 per cent on account of retreating of index, 0.4 per cent were received broken, 0.5 per cent were broken in testing, and 6.4 per cent exceeded the limits of allowable errors.

In addition to the above, there were tested a total of 7 platinum resistance thermometers and 1 indicator for a platinum resistance thermometer.

Among the calorimetric tests made by the Bureau, 11 were for the heating value of fuel oils and bituminous materials, 2 of calorifiers (instruments for transferring a known amount of heat), 4 of gas calorimeters, 253 standard heat samples, 1 for the specific heat of linseed oil, and 1 for the determination of the water equivalent of a bomb calorimeter.

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In the high-temperature laboratories there were tested 3 radiation pyrometers, 11 optical pyrometers, 1 absorption glass for optical pyrometers, 35 rare-metal thermocouples, 8 base-metal thermocouples, 6 thermocouples with pyrometer galvanometers, 3 pyrometer galvanometers, and 14 homogeneity tests of thermocouples.

Among tests involving the melting points of various materials, 9 were for fire brick, 11 for concrete material, 3 for high-temperature cements, and 3 for metals.

Besides the above testing, a number of special tests were made involving 3 fire tests of building stones, 6 determinations of the melting points of samples of ceresene, 1 determination of the melting points of samples of paraffin, 6 cold tests of rubber samples, several determinations of the freezing points of samples of fire-extinguisher fluids, 9 efficiency tests of refrigerators, and 30 determinations of thermal conductivities. Other special work carried on was the preparation of a special steel ingot, soft outside and hard inside; a study of the behavior of silicon carbide ware in air at 1,800° C.; the preparation of carbides in an electric furnace; a study of the temperature conductivity of bales of cotton; and the standardization of a pyrheliometer.

Almost every variety of industry and manufacturing interests is represented in the above summary of tests, as well as Government, State, and municipal bureaus and commissions, technical schools, universities, etc. Among the thermometers tested were included a number of working standards used by manufacturers to control the accuracy of thousands of thermometers put on the market; the clinical thermometers were tested for the several medical bureaus of the Government, State medical institutions, manufacturers, hospitals, dealers, physicians, and individuals; calorimeters were tested for the gas industries and State commissions; and standard heat samples were furnished to numerous industrial plants using large supplies of fuel. In the high-temperature tests of pyrometers, melting points, etc., are represented every variety of industry in which the control and measurement of high temperatures is an important factor in the product of the plant, such as iron and steel plants and allied industries, cement, gas, and ceramic plants; electric manufacturing companies; manufacturers of high-temperature measuring apparatus, tools, springs, axles, automobiles, etc.; as well as technical and university laboratories, etc.

Of the total work of testing done by the division of heat and thermometry, somewhat less than half is done for the various bureaus of the Government, the remainder for the general public.

Information Furnished, Reports, Etc.

An important feature of the work of this division has been the information that has been furnished by means of letters, and often quite complete reports, on subjects related to its lines of work. Several hundred such communications were prepared during the year. The requests for information came from nearly every type of industry; from manufacturers; National, State, and municipal laboratories and bureaus; from scientific investigators; from committees of engineering and technical societies; and from many others. The subjects treated were of every variety; for example, thermometry;

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thermometer specifications; comparators for testing thermometers; thermoelectric pyrometers; cold junction corrections; optical pyrometers; radiation pyrometers; installations suited to particular requirements; calorimetry; heating value tests of gases; specific heats of liquids and gases; heats of combustion of gases; definition of the British thermal unit; melting points of oxides, fire bricks, ash, cements, etc.; refractory glazes; decomposition temperature of calcium carbonate; thermal conductivities of insulating materials, bricks, etc.; apparatus for testing thermal conductivities; testing of steel car sections; containers for molten oxides; tests of refrigerators; fire tests of insulated steel cabinets; baffle plates and burners; viscosity measurements; conversion tables; flash-point testers; resistance of pipes to the flow of liquids and gases; design of gas-burner nozzle; design of aeroplanes and windmills; windage of fly-wheels and steam turbines; ventilation; commercial separation of oxygen and nitrogen by air liquefaction; uses of liquid air; heat of sublimation of ice below 0° C.; rules for the computation of horse-power of hydraulic and steam turbines; and condensation of moisture on iron car roofs.

New Work and Equipment for Heat and Thermometry.

A number of metals and salts, of accurately determined melting points, should be certified by the Bureau and supplied to technical men to enable them to quickly and conveniently check the accuracy of their pyrometers, just as standard combustion samples now furnished by the Bureau serve to check heating value tests. Numerous requests have been received by the Bureau to furnish such standard melting-point samples. The necessary preliminary work to issuing such samples can be started as soon as funds are available for purchasing a sufficient supply of materials. The fees received for the standard samples would nearly, if not quite, pay for the work and materials.

A number of important items of equipment, which have been deferred from year to year, are urgently needed and should be provided for, such as electric furnaces, heavy current transformers and rheostats with the necessary special wiring, thermocouples, refractory porcelain for high-temperature work, bomb calorimeters, gas tanks, standard thermometers, and a new resistance bridge.

3. ELECTRICITY.

Weston Standard Cell.

Studies continue in progress on the Weston normal cell, the primary standard of electromotive force. The aim of this work, which has extended over a number of years, is to secure control over all the factors affecting this fundamental standard. Cells may then be constructed according to a definite procedure, such as to have a predetermined electromotive force accurate to a few parts in a million, and such as to continue unchanged indefinitely. The chief source of variation in the cell is the mercurous sulphate. It has been ascertained that this substance, when prepared by alternating-current electrolysis, gives very constant electromotive force, but different samples do not quite agree. The study of these differences is

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actively in progress. It has been found that the preliminary washing produces negligible effect, while acid strength and temperature are important causes of variation. The effects of the rate of stirring and size of grain are under investigation, indications being that fine-grained samples give higher electromotive forces than the coarser-grained samples.

The type of standard cell used in ordinary electrical measurements, the unsaturated Weston cell, is under investigation as to its reproducibility and constancy. Such cells when set up with alternating-current mercurous sulphate were found to be very constant.

Mercury Standard Ohm.

The unit of electric resistance is defined by international agreement in terms of a specified column of mercury in a glass tube at the temperature of melting ice. Such standards have been set up at the Bureau, and the paper describing the work is in press. (See Scientific Paper No. 256.)

Silver Voltameter.

The international ampere adopted by the International Electrical Congress (London, 1908) as one of the two primary electrical standards is defined as the continuous current which deposits silver from an aqueous solution of silver nitrate at the rate of 0.00111800 gram per second, under certain conditions. The instrument used in making such deposits of silver is the silver voltameter. Many investigators have published the results of their experiments with this instrument, but at the time of the electrical congress much remained to be learned about it. The Bureau has actively prosecuted its researches in this subject for several years past and has published six papers on the subject. During the last year the Bureau has cooperated with Prof. Hulett, of Princeton University, who had previously made an extended study of various voltameter problems. The results of this work include the discovery of a hitherto unsuspected source of error in washing the deposits of silver. The Bureau's work and Prof. Hulett's work have now been brought into excellent agreement. (See Scientific Paper No. 240.) The last few months have been spent in an effort to determine the amounts of foreign substances deposited with the silver. These are commonly called "inclusions." A considerable number of deposits have been heated to over 600° C. both with a flame and in a furnace to expel these inclusions. The very concordant results which have been obtained indicate the inclusions to be about 0.004 per cent on the average when the electrolyte is pure. This Bureau has previously published 0.00111804 as the value it has determined for the electrochemical equivalent of silver by means of its voltameters and absolute current balance. The latest work on inclusions, mentioned above, now makes it appear that the value 0.00111800, the figure adopted by the London Electrical Congress, is the best assignable value for the electrochemical equivalent. On the above basis we are now able to compute anew the value for the faraday, which is an important constant in the science of physical chemistry. It is equal to 107.88 (the atomic weight of silver) divided by 0.00111800, which is 96,494 coulombs.

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This value can not be accepted as settled, however, inasmuch as official specifications for the silver voltameter have not yet been agreed to internationally. It is probable, however, that the value 96,500 for the faraday is within a hundredth of 1 per cent of the true value expressed either in absolute or international coulombs; that is, coulombs defined in terms of the absolute or international ampere, which are numerically in extremely close agreement.

Inductance of Electrical Shunts.

A study has been made of the inductance of resistance standards such as are used in the measurement of large currents. (See Scientific Paper No. 246.) The ordinary methods can not be used for the measurement of such inductances, because these standards are four-terminal conductors of a special form. Two methods were devised for the purpose and were found to work well in the laboratory.

Simple Method for Testing Electrical Instrument Transformers.

A method was developed for testing instrument transformers by the aid of ordinary watthour meters, such as are used in buildings to measure the consumption of electrical energy. (See Scientific Paper No. 233.) Attempts to determine the ratio and phase angle of these transformers by using watthour meters in both primary and secondary circuits have not met with much success. The method here developed is to determine simply the difference between two transformers, one of them being a standard. It was discovered in connection with this work that commercial watthour meters are constant enough in their performance to serve as test instruments in this comparison, their variation in successive tests being surprisingly small.

Measurement of Earth Resistivity.

A knowledge of the electrical resistivity of earth is often necessary in connection with grounding electrical systems and in the study of the effect of stray currents in the earth. An improvement in the methods of measuring earth resistivity has been made by using four electrodes and considering the measurement to be that of a four-terminal conductor. The troublesome large resistances at the electrodes are thereby eliminated. A paper describing the method has been prepared.

Standard Air Electrical Condensers.

For some time there has been a need for better standard air condensers for use in the alternating current measurements at the Bureau. Such condensers consist of two sets of metal plates interleaved with one another, the two sets being electrically insulated from each other. It is very difficult to make them mechanically rigid. Great improvements have been made in this respect by a new design using quartz insulators. A number of the new condensers have been constructed, and are found to have a very constant electrical capacity. The capacity does not change with frequency of charge and discharge.

New air condensers have also been designed and constructed for use in radiotelegraphy. The plates have a spiral shape, such as to facilitate many of the high-frequency measurements.

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Galvanometers.

One of the investigations in progress relates to the sensitiveness of galvanometers. These are used in various kinds of electrical measurements in which the accuracy or precision must be high; such, for example, as the comparison of resistance standards (on the values of which measurements of electrical power depend) and the measurement of temperature to 0.001° C. by means of resistance thermometers.

A paper on the general design of sensitive galvanometers has been prepared. The paper gives and discusses the mathematical relation between the operating constants of a galvanometer and the factors entering into its construction, such as the magnetic field and the shape, size, and kind of material of its parts. Procedures are outlined for the construction of galvanometers for various particular purposes.

For industrial purposes alternating current is largely used. This has necessitated the development of methods for testing alternating-current apparatus and as progress is made there is a demand for higher accuracy in the measurements. Where a high accuracy is required null or balance methods are usually employed and these require some kind of detector which will give a definite indication when an alternating current is passed through it. For certain classes of work a telephone receiver answers the purpose very well, but for alternating currents of low frequencies it is very insensitive. In such cases the vibration galvanometer is much more sensitive and is used to a considerable extent. In some classes of work, however, there is a need for a still more sensitive detector. By a careful study of the problem, making use of the experience gained in the construction and use of sensitive galvanometers for direct current, alternating-current galvanometers of high sensibility are being developed. The theory of the separately excited galvanometer has been studied and such instruments have been constructed and used. The performance of these galvanometers can be varied by changing the constants of the circuits to which they are connected. They can be made as sensitive as the best direct-current galvanometers, and are particularly useful in alternating-current bridge measurements. A scientific paper on these instruments has been prepared for publication.

Parallel-Decade Potentiometer.

An improvement in the accurate measurement of temperature has been made possible by a new potentiometer designed here and constructed during the spring. The small electromotive forces used in the thermoelectric method of temperature measurement can be measured with increased accuracy by means of this instrument. The settings of the potentiometer are varied by moving a high-resistance shunt from one set of coils to another. Thermal electromotive forces generated at the sliding switches do not materially affect the measuring circuit.

Circular on Electric Measuring Instruments.

Bureau Circular No. 20 has been thoroughly revised and brought up to date. This new edition was prepared with the cooperation of

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a number of engineers and instrument makers and the meter committee of the National Electric Light Association. This necessitated a number of conferences and considerable correspondence. The circular presents the principles underlying the construction and operation of commercial electrical instruments, together with information concerning the advantages and limitations of the various types such as will assist the user to determine which general type is best suited to a given purpose. The design, sources of error, and the testing of electric instruments are treated.

Measurement of Conductivity of Electrolytes.

The electrical division cooperated with an investigator working under the Carnegie Institution of Washington in this research, the work being done at the Bureau. Most liquid conductors of electricity are electrolytes, and no satisfactory methods of measuring their conductivity have hitherto been perfected. To eliminate disturbing factors, one of the first requirements is a source of alternating current free from harmonics. Several types of generators were investigated, and one was found suitable. A satisfactory measuring bridge was developed. The conditions were found for eliminating the effect of change in voltage upon the measured conductivity. The effect of frequency of the measuring current and the effect of the type of electrodes were studied. Very high accuracy was attained in the final measurements.

Resistance and Inductance of Bimetallic Wires.

Wires made up of a steel core with an outer copper sheath are used in electric power transmission and in telephone work; having greater strength than copper wires, they can be used in longer spans. Accurate data on the electrical properties of these wires has been lacking. The resistance and inductance vary with the frequency of alternation of the current. Measurements of these quantities were made, and formulas and tables prepared, for the commercial sizes and grades of copper clad steel wire and iron telegraph wires. (See Scientific Paper No. 252.) In connection with the work, a study was made of the magnetization of an iron wire by a current flowing through it.

Magnetic Method of Determining Flaws in Steel Rails.

An examination of the possibility of detecting flaws in steel rails by a magnetic method has been in progress for some time. Two 15-foot sections of an 80-pound rail were used. Artificial flaws introduced into these specimens can be located by magnetic measurements made with large coils which are arranged to slide along the rails. This investigation is carried on in cooperation with the engineering division of the Bureau, the mechanical tests and magnetic tests being complementary. The results so far obtained indicate that the magnetic method of finding flaws in rails may possibly become commercially feasible, although much remains to be done in that direction.

Correlation of Magnetic and Mechanical Properties.

The investigation seeking to correlate the magnetic and mechanical properties of steel continues in progress. Data have been collected

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on the magnetic and mechanical properties of several series of carbon and alloy steels after different heat treatments.

Magnetic Permeameters.

A thorough investigation of an important type of permeameter was completed during the year. (See Scientific Paper No. 228.) This is an instrument for measuring magnetic permeability, and has been extensively used in the past for commercial testing. This permeameter consists essentially of a magnetic circuit in which there is interposed a suspended coil carrying a constant current. A deflection of the coil is a measure of the induction through the specimen of iron under test. It was found that the indications of the instrument require corrections in some cases as large as 100 per cent. The correction is different for different grades of test specimens. It was concluded that with great care in its use, such a permeameter is capable of yielding results sufficiently accurate for commercial requirements.

A new permeameter has been developed at the Bureau. It is capable of measuring permeability with speed and accuracy. By its use it was found that some of the standard magnetic bars prepared by the laboratory five years ago were not sufficiently homogeneous. A new set of standard bars has been prepared, examined for homogeneity, and carefully measured for their magnetic constants.

Temperature Coefficient of Magnetic Permeability.

Magnetic tests of iron are ordinarily made without regard to the temperature of the specimen. When an accuracy of 1 per cent in the permeability is required, the temperature has to be considered. An investigation just completed has shown that temperature coefficients may be as great as one-third of 1 per cent per degree. A knowledge of this is important not only because room temperatures vary, but also because the bar of iron may be 10° to 20° C. higher in temperature than the room, owing to the heat developed in the magnetizing coils. The results of test on a given material can not be corrected to standard temperature by means of data obtained from other materials, because the temperature coefficient is different for different materials and even for the same material with different heat treatments. The only generally reliable way to avoid errors arising from the effect of temperature upon permeability is to regulate the temperature of the specimen under test. (See Scientific Paper No. 245.)

Core Losses in Iron at High Inductions.

One of the chief considerations in the design of dynamos and other electric power apparatus is the limitation of power loss due to heating in the iron. It is, therefore, of great importance to have an accurate knowledge of the behavior of iron when subject to magnetizations such as cause large losses of power. This has been the subject of special study for some time past. It has thus far been possible to extend the measurements from the former limit of 10,000 to 15,000 units of induction.

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Magnetic Circular.

Bureau Circular No. 17 on magnetic testing has been revised and extended and will shortly be issued. The methods used at the Bureau are explained in detail. This information has frequently been sought in inquiries addressed to the Bureau. Information is given upon empirical formulas for approximate calculations of induction and core loss. Typical characteristics of ordinary commercial magnetic materials such as are used in electromagnets and permanent magnets are given. The circular is a valuable compendium of information on magnetism.

Radium Testing.

There has been a great increase in the volume of testing which the radium laboratory has been called on to do for the public. The apparatus for the testing of radium salts is being improved. The Bureau has been called upon to measure single specimens that contain nearly 16 times as much radium as the largest standard. To facilitate such work a set of lead filters has been carefully standardized. By screening the electroscope with lead plates, it has been found possible to measure satisfactorily a specimen containing 16 times as much radium as the standard. Further studies in connection with such measurements are being made. The method is not, however, so satisfactory as it would be if the laboratory possessed a supply of radium more nearly comparable with the large specimens sometimes submitted for test.

Increase in the Bureau's Stock of Radium.

An increase in the Bureau's stock of radium is needed. The Bureau should have a much larger standard of radium than at present. Large test specimens could then be standardized by a more direct comparison, and the present 15 milligram standard could be placed in the vault and retained with greater safety as a primary standard.

Alpha Ray Activity of Uranium Oxide Powder.

A study of the alpha ray activity of uranium oxide powder has thrown doubt upon the validity of such activity as a guide to the amount of radioactive material contained.

Radium Emanation.

Second only in importance to the study of radium salts is the investigation of radium emanation. Such work has been carried on throughout the past year. The equipment is being continually improved. An interesting auxiliary is a 1,500-volt battery made up of dry cells such as are used in flash lights.

Circular on Radium.

Part of the work of the radium laboratory is to act as a clearing house of information. Attention is being given to the indexing and abstracting of the literature on radium. A circular is in preparation, setting forth in a popular manner those facts concerning radium and radioactivity and their technical measurement which are of general interest or which should be clearly understood by all who desire to employ radium or the allied substances in any way.

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Radio Communication.

The radio laboratory has assisted the Bureau of Navigation of the Department of Commerce with technical information from time to time, and has designed, tested, and adjusted instruments used in examining the radio equipment of ships by the inspectors of that Bureau.

Radio Sets for Lighthouse Tenders.

Five complete radio equipments for the Bureau of Lighthouses were designed and their construction supervised by this laboratory. They are installed on lighthouse tenders and are provided with a number of special features adapted to the needs of the lighthouse service. As a result of the attention given to the design of these sets, they were purchased at a smaller price than the usual commercial sets of the same range, and are much more efficient in the service for which they are intended. In the development of this equipment, valuable experience and information were gained which could hardly have been obtained in any other way. The tenders equipped with radio apparatus will be of greater service in promoting safety at sea than ever before. Being at no time cut off from communication with the lighthouse or with ships, they will be a much greater aid to navigation.

Radio Interference.

An investigation was made of a case of alleged interference caused by a large power arc operated by a commercial company, at the request of the Bureau of Navigation. Other companies and the Navy Department complained that this company was sending out wave lengths not allowed to it by law, such as to cause troublesome interference with radio messages from other sources. The company claimed that it was sending only wave lengths within the legally prescribed limits. A study of the waves actually used by the company showed that while the main sending wave length was as the company claimed, the apparatus gave rise to subsidiary and shorter waves which caused the trouble. It has not heretofore been recognized that arc generators may send out reinforced harmonics of the fundamental wave in such volume as to cause interference.

Promotion of Safety at Sea.

Some improvements in radio apparatus are being developed which will be of assistance particularly to those branches of the Government having to do with the protection of life and property at sea. One of these is a fog-signaling device. With such a device automatically sending out radio waves, either on a ship or at a lighthouse, other ships could navigate in a fog with greater safety. Another device which if successful would be of great assistance in navigation is a direction finder. This relatively simple apparatus permits the operator of a radio set to determine from what direction a message is being sent. This should be of great advantage, especially in emergencies. The device is under study.

Design of Inductance Coils for Radio Work.

A study has been made of the practical design of inductance coils for use in high-frequency circuits, such as wave meters, receiving

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tuners, and transmitters. The inductance coil is one of the two most important elements of a radio circuit, and information as to the proper design of such coils is being continually sought by the manufacturer and user of radio apparatus. A number of coils have been received from manufacturers, colleges, and Government departments, and tested at frequencies ranging from 50,000 to 1,000,000 cycles per second.

Proposed Work in Radiotelegraphy.

A number of additional lines of work in radiotelegraphy have been either begun or planned for the coming year. The design of radio apparatus is at present limited by lack of precise data on the high-frequency resistance of conductors of various forms. Investigation will, therefore, be made of the resistance of straight wires and strips and coils of various shapes, wound with various kinds of wires, and mounted in various ways. Of like importance is new data on the dielectric losses in various types of radio condensers. The methods of measuring resistance, current, and wave length at high frequencies are being studied.

Information as to the behavior of different types of antennas is urgently needed. At present the ground resistance, radiation resistance, and other characteristics of various types of antennas can not be determined with great accuracy. The methods of measuring resistance and capacity of antennas should be studied, together with the question of the dielectric and hysteretic properties of the soil. Permanent towers are needed, upon which experimental antennas can be mounted, so that the problems now in hand and others which will arise may be adequately treated.

The use of radiotelegraphy by this Government to promote safety and as an aid to navigation has been by no means as thoroughly developed as it might well be. This Bureau hopes to be of greater assistance to other civil branches of the Government in the future than it has been able to be heretofore, particularly to such as are engaged in the protection of life and property at sea. Such assistance may take the form of information upon the technical possibilities of radio instruments and equipment, the standardization of apparatus, and the adaptation of radio equipment to the particular needs of a given service.

Additional Facilities Needed in Radiotelegraph Work.

The increasing requirements of the radiotelegraphic work, as to space and experimental facilities, necessitate a separate building. Auxiliary to the building there should be two towers about 150 feet in height for the support of experimental antennas. The building would house not only the radio laboratory of the Bureau but also those of the Army and Navy, now located in a few of the rooms of the Bureau laboratories. Considerable work has been done in the Bureau laboratory, as has already been outlined on preceding pages, but the rapidly increasing importance and range of radiotelegraphy demands a considerable extension of the work, for which the present space and facilities are quite inadequate. Not alone the design of radio apparatus and the assistance of other bureaus in securing suitable equipment, but a thorough study of the scientific principles underlying the art, are urgently needed. An appropriation of $50,000

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for a building for this work has been requested. This request is renewed. An increase from $10,000 to $20,000 of the appropriation for apparatus and for assistance in connection with the radio work is also desired. The Bureau of Standards is an ideal place for the location of a well-equipped radio laboratory. The close proximity of the radio laboratory to the other scientific and instrumental resources of the Bureau would be a distinct advantage. The building would be two stories in height, would be located south of the electrical laboratory, and would be connected by means of a tunnel with the other buildings, so that all the generators and other facilities of the Bureau would be directly available.

Effect of Atmospheric Conditions on Flame Standards of Candlepower.

In the pursuit of its plans for putting tests of gas on a more exact basis, the Bureau found it necessary some years ago to make a special study of the flame standards of candlepower which are used for such tests. In order to be able to calibrate such lamps accurately at all seasons of the year a precise knowledge of the effect of atmospheric conditions was necessary, for variations due to these conditions may be as great as 20 per cent. Thorough determinations of the effect of humidity were made, the results of which have been confirmed by all the more recent tests.

In order to certify the candlepowers which the standards would have in cities at different altitudes, however, it is necessary also to know the effect of changes in barometric pressure, and the natural variations in pressure in Washington were not sufficient to determine this effect over the required range. A set of tanks was therefore constructed in which the lamps could be supplied with the proper flow of air at a high or at low pressure, while the corresponding candlepowers were measured by a suitable photometer.

Such measurements have been made on the best types of standard lamps and also on the types of gas burners most commonly used in tests. The same apparatus has been used for exact determinations of the effect of humidity on the gas flame, which has never before been made. This work is now ready for publication, and will show more fully than has heretofore been done the real significance of the results of tests of gas under various conditions.

Photometry of Lights of Slight Color Difference.

The tendency in recent developments of lamps has been continually toward the production of whiter light, so that exact comparison with the older standard lamps to which all our measurements must be referred becomes increasingly difficult. The work done last year in determining the equations of curves showing the changes in candlepower and efficiency of tungsten lamps when the voltage is changed has been published in Scientific Paper No. 238, and the results have been widely used in lamp factories. Another paper, dealing particularly with certain peculiar difficulties which arise in the measurement of the new gas-filled incandescent lamps, has been prepared for publication.

All measurements of lights differing in color from the fundamental carbon standards have hitherto been essentially unsatisfactory, for

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two reasons—in the first place it is very difficult for any one to judge when equality has been obtained in the photometer, and hence the results vary erratically; in the second place, when enough measurements have been made to average out these erratic variations there still remain differences between individuals. In other words, the candlepower really is different for different observers, and the proper value to assign is that which the average person would get.

It is hardly justifiable to assume that the few men in a laboratory fairly represent the average of people in general unless some test has been made to show their relation to that average. Such tests have recently been devised, but have not been sufficiently well tried out to be generally adopted.

The Bureau (in cooperation with the research committee of the Illuminating Engineering Society) has planned an extensive investigation to consist of (1) the establishment of average values by having 100 or more observers make measurements on certain colored lights; (2) a test of the proposed method of choosing observers who properly represent the average thus established; and (3), if the method proves to be practical, the calibration of colored glasses, solutions, multivoltage standard lamps, and other devices which are used to obviate the difficulty due to color. This work is just being started and is to be prosecuted as actively as possible during the summer, while the amount of routine testing is small.

Illuminating Engineering.

Provision is needed to enable the Bureau to take up in an adequate manner some of the most urgent problems in illuminating engineering that concern municipalities. The lighting of streets and public spaces, public buildings and auditoriums, stores, factories, and private homes is a matter that is receiving a great deal of attention in recent years, and a great many new and improved methods, as well as fixtures and appliances for the purpose, have been developed; but reliable information as to the value of much of this material is hard to obtain.

The claims made by manufacturers are often conflicting, and there is a great need for an unbiased agency, such as the Bureau of Standards, to make photometric and other tests and to determine the performance of the appliances that are on the market. For the use of the Government, States, and cities alone such information would be of great value, but it would also be of immense value to the general public, and particularly to architects and contractors who are specifying and purchasing such appliances. We know also from tests which we have made that improvements at practically no cost could often be made if the necessary information were available. The subject is a highly technical one and directly in line with the Bureau's work, and a moderate appropriation would yield valuable results.

During the past year information has been collected regarding street lighting from a large number of cities, and it is expected that a careful study of this data will furnish results of interest to many cities. Some of the experimental work done is mentioned under the heading "Photometry."

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Electrical Testing.

Standards, instruments, and materials are tested by seven sections of the electrical division. In the following enumeration, the more important tests for the Government are so indicated.

Standard cells and resistance apparatus.—Tests were made during the year on 74 Weston portable cells, 6 Weston normal cells, 1 Carhart-Clark cell, 11 precision rheostats, 5 potentiometers, 8 volt boxes, 9 wheatstone bridges, 12 resistance standards for current measurement, 83 precision resistance standards, and 99 wires and cables for conductivity measurement. Of the last item, 95 were for the Panama Canal.

Capacity and inductance.—The tests for capacity and inductance included 17 electric condensers, 6 inductance coils, 2 measurements of inductance of resistance coils, and 7 insulation resistance tests. A test was made of the dielectric constant of some varnished cambrics for use in a high-voltage transformer. It was found that the apparent dielectric constant varies with the air space in the condenser in which the material is used. The effect increases with the heterogeneity of the dielectric.

Radium.—There were tested by the electric division during the past year 82 specimens of radium and mesothorium. These specimens, 14 of which were for the Government, aggregated 2.127 grams of radium, valued at $254,000. One large test was of 250 miligrams for Italy, for use in hospitals and laboratories there. Some of the specimens in this lot were found to be mounted in a slightly defective manner; this case is an example of the service which the Bureau frequently renders by pointing out defects in standards as well as testing them. There were also 3 tests of emanation of radioactive water, 11 standard solutions and emanation standards, and 2 samples of radioactive material. The last was a special test for the Department of Agriculture.

Electric measuring instruments, etc.—The following tests were made for the public: 14 voltmeters, 22 ammeters, 13 wattmeters, 30 watthour meters, 18 voltage transformers, 32 current transformers, 2 special transformers, 12 samples of wire, 5 samples of tape, 6 pairs of rubber gloves, 2 recording potentiometers, and 8 dielite cylinders. The following articles were tested for the Government: 7 voltmeters, 4 ammeters, 2 wattmeters, 3 watthour meters, 1 current transformer, 15 motors, 35 dry cells, 16 samples of wire and cable, 38 samples of tape, 1 sample of varnish, 2 samples of sheet insulation, 34 transformer coils, 150 pairs of rubber gloves, 15 porcelain insulators, 1 glass insulator, 4 electric "healing" devices, and 37 electric fans. The electric fans were tested for the General Supply Committee. Measurements of air delivery and relative efficiency are used by the General Supply Committee in awarding the annual contracts for electric fans.

Magnetism.—Magnetic materials tested during the past year included 69 samples of iron for measurements of normal induction, 21 determinations of hysteresis, 51 core loss measurements, and 3 miscellaneous magnetic tests.

Photometry.—1,253,504 electric lamps were inspected and 3,141 lamps life tested for the various Government departments; of the

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former 692,745 lamps were tungsten and the rest carbon, and of the latter 2,400 were tungsten and the rest carbon. Other tests for the Government were 86 reflectors and globes, 4 spherical reduction factors of electric lamps, 30 samples of kerosene and signal oils, 2 portable photometers, 1 illuminometer, 1 comparison of illumination from motion-picture machines, 1 test of acetylene signal lamps, and 21 gun-sight lamps. The following tests were made for the public: 140 incandescent lamps tested for candlepower, 2 color screens, 11 pentane lamps, 1 Hefner lamp, 1 sample of pentane, 1 retinal sensivity tester, 2 luminous arc lamps, 1 kerosene mantle lamp, and 4 luminous-flame oil lamps.

Besides routine tests of lamps, reflectors, photometers, etc., the following tests of special interest have been made. Samples of the two most widely used types of "luminous arc" lamps for street lighting were tested to determine their efficiency, the distribution of the light, and the life of the electrodes. Comparative measurements of the illumination furnished by several kinds of motion-picture machines were made as a basis for the choice of a type of which a large number were to be purchased by various Government departments. An acetylene signal lamp used by the Coast and Geodetic Survey for long-range triangulation was tested and experiments were made to show the great increase in intensity which could be gained by using a concentrated filament electric lamp instead of the acetylene flame. A kerosene mantle lamp was measured in comparison with luminous flame lamps and found to give about four times as much light for a given consumption of oil. Photometric tests of kerosene oils have only recently been begun by the Bureau; this year 30 samples were tested for the Government following the procedure outlined in the specifications. The specifications are not sufficiently definite in many respects, and when possible the tests have been made under different conditions to determine the effect of various factors not sufficiently well defined. Although kerosene is the illuminant used by more people than any other, its effective use has received comparatively little study, and considerable effort might profitably be expended in determining the properties of the oil which affect its illuminating value.

Among the photometers calibrated was one to be used by the Public Health Service in studying illumination in factories and in some of the Government offices. Another photometer, which was tested for the Weather Bureau, was fitted with reducing screens and color screens to extend the range of the instrument so as to make possible measurements of intensities up to that of direct sunlight, while a third, intended for the Bureau's street-lighting investigations, was fitted with absorbing screens to make possible the measurement of illumination in poorly lighted streets; the extreme range covered by these instruments was such that the highest illumination measured was about 1,000,000 times the lowest.

The life tests made on incandescent lamps supplied under Government contracts showed that the quality of these lamps is being steadily improved, so that although the requirements of the specifications have been materially raised in the last year nearly all the lamps supplied to the Government passed the life requirements by a considerable margin. The advantage gained by conducting these tests

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is well illustrated by the results of a test made by the Bureau on lamps supplied by contractors to the State Hospital of New York, where tests are not regularly made. It developed that the lamps which were being supplied were decidedly inferior to those which the Federal Government obtains. A few tests of the life of lamps were also made for private parties in cases where circumstances made the tests of sufficient importance to justify the work being done here.

Considerable time was spent on a test of gun-sight lamps for use in the Navy. This included a determination of the best intensity for such use and a test of several types of lamps made up for trial. A satisfactory form was finally obtained, and specifications for it formulated.

Radio instruments.—Tests of radio instruments included 5 wave meters, 5 inductance coils, 1 variable condenser, and 10 decremeters, 5 of which were made for the Government.

The above list of tests does not include a considerable number of magnetic tests, tests of Weston cells, etc., made for various laboratories of the Bureau.

Information Furnished on Electrical Subjects.

A large part of the work connected with the various investigations and tests consists of correspondence, in which scientific and technical information is furnished by the Bureau. Information is also frequently furnished in replying to particular requests. Some instances from the correspondence of the electrical division during the past year may be given.

A great many inquiries regarding radium and radioactive preparations were received and answered. The subjects included the testing of therapeutic preparations, water activators, etc. The correspondence shows the need of a circular of information on radioactivity. This has been in preparation and will shortly be issued.

The Bureau is a repository, not only of scientific, technical, and commercial standards, but also of exact information in regard to units and standards. Compilers of physical tables seek such information from the Bureau. Material on units and electrical data were furnished for new editions of two books of tables during the year.

A variety of information has been furnished on the subject of radiotelegraphy. Suggestions for research, bibliographies, data on design and performance of coils, and particulars regarding the practical details of radio stations were among the information supplied.

Valuable service has been rendered by preparing opinions as to the technical worth of certain fraudulent devices. One of these was a primary battery alleged by the inventor to have extraordinary efficiency. It was supposed to be such an economical source of energy as to be superior to dynamos for the supply of electric heat, and could be used for the heating of houses. These claims have been used to extract large sums of money from the public. An inspection of the battery and a few simple tests showed that the claims amounted to a contradiction of well-known laws of nature, and that the battery is in the ordinary class of batteries such as are used for door bells and signal systems. In such cases, the Bureau cooperates with other branches of the Government concerned. Sometimes the case

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leads to court processes, and sometimes to postal fraud orders. Another class of electric fraud embraces a number of devices supposed to cure diseases or otherwise benefit the human body. Several of these were submitted and examined during the year. "Electric" and "magnetic" rings and other appliances for the cure of all bodily ills have had a vogue for many years, and it is extremely difficult to eradicate them. Possibly a public statement as to their utter absence of electric or magnetic action will be of some assistance in discrediting them.

Public-Utility Investigations.

The electrical work so far mentioned has to do with the determination and maintenance of electrical standards, the investigation of methods of measurement, study of the electrical properties of materials, the design and improvement of instruments, and the testing of instruments and materials, all of this being done in the fields of electricity, magnetism, and photometry.

Another large and important field of work, some of which has more of an engineering character than most of the work so far described, is concerned with the various public utilities, particularly the electric light and power, gas, street-railway, and telephone companies. The work includes scientific and engineering research, the study of public relations questions, the preparation of specifications regarding the quality of service, methods of testing and inspection employed by municipalities and commissions, safety rules for use by the utility companies to safeguard their employees and the public, and the collection and distribution of information by published papers and through correspondence.

Service Standards for Illuminating Gas.

This work has been carried on for several years under the direction of the electrical division, with the cooperation of the other divisions of the Bureau, especially the chemical and heat divisions. Regulations for gas service, as made by cities or State commissions, include among other things the requirements as to meter accuracy and the testing of meters, the specifications of the heating value or candlepower of the gas (or both), the degree of chemical purity as expressed by the limits set to the amounts of sulphur and ammonia that are permitted, the variations in pressure that may be allowed, and the manner and frequency of tests to determine whether the operating companies conform to the requirements.

In addition to investigations carried on by the Bureau for the past five years on this subject, which have resulted in a considerable number of papers published in the Bureau's scientific and technological series, a careful study was made of the rules and regulations of cities and States, and a thorough discussion made of the subject in Bureau Circular No. 32, first published four years ago. This was revised and republished two years ago and a third edition has been prepared and published during the past year. This publication has had a wide circulation and serves a most useful purpose in setting forth the proper basis for regulations; it also discusses the relation between the quality of gas and the efficiency of manufacturing processes, and the most satisfactory terms in which to specify gas quality and methods of testing.

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This circular also contains model ordinances for the use of cities which control their own utilities, and state rules suitable for the adoption of State commissions which fix the standards of service for all the companies of a State.

In the original preparation of this circular as well as in its subsequent revisions the Bureau has had the cooperation of the gas industry, a special committee of the American Gas Institute having read the manuscript and offered suggestions. Many engineers of cities and commissions also gave similar assistance.

The advantage of having such cooperation between representatives of the industry, of the public, and of a disinterested national institution that is possessed of ample experimental facilities is obvious. It results in rules and requirements that are more nearly just and adequate, gives to the public greater confidence in the service of the utilities, and makes recourse to the courts much less frequent.

Another publication issued during the year is Circular No. 48, which gives a detailed technical discussion of methods of gas testing. This was the joint work of several divisions of the Bureau.

The Bureau has given assistance to a considerable number of State commissions and cities in connection with the adoption of ordinances or orders regarding gas service, and has sent a representative to a number of public hearings conducted by State commissions during the year. It is of much importance that the regulations and requirements of the several States and cities shall be as uniform as consistent with progress and justice to the companies and the public. The Bureau aims to serve in some measure as a clearing house of information on many of the scientific and public relations questions arising in connection with the regulation of gas companies, and to be perfectly impartial as between the companies and the public.

Electric Light and Power Service.

During the past two years the Bureau has been studying the question of the specifications for electric light and power service, and the requirements that should be made by cities or State commissions of public-utility companies furnishing such service. This study is similar to the studies described above concerning gas service and the conclusions and recommendations resulting from the study will be shortly published as Bureau Circular No. 56. The principal factors of such service are its quality and reliability, and the accuracy of the meters that measure it. Steadiness of voltage and continuity of service, without which electric lighting is not satisfactory, are phases of quality and reliability that have sometimes been included in regulatory ordinances, while the permissible errors of meters and frequency of testing of the same are almost always included. As the requirements that can fairly be made differ under different circumstances, it has been necessary to prepare more than one set of specifications for cities. Hence, three model ordinances have been prepared, one for large cities, one for medium-sized cities, and one for small cities and towns. In the first the requirements are more detailed and the quality of service required is higher than for smaller places. In the third, requirements are fewer and inspections by the city or town are not contemplated; but the character of service to be expected is specified and there is a basis for further requirements when practicable.

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A set of rules suitable for adoption by State commissions has also been prepared, and a digest given of the requirements of all the rules now in force by commissions.

In this work also we have had the cooperation of the electric companies and State commissions, many valuable criticisms and suggestions having been received after reading the manuscript. The Bureau has cooperated for years with the meter committee of the National Electric Light Association, and one of the important subjects of the new circular is meter testing and meter accuracy.

At the invitation of public-service commissions, representatives of the Bureau have attended a number of hearings in various States where proposed rules for the regulation of electric service were under discussion, and have given commissions assistance in formulating such rules. In every case the Bureau seeks, while representing the public interest, to get the utility's point of view also, and has always consulted the utilities concerned before publishing any proposals or suggestions as to rules or regulations.

Cooperation with the Underwriters' Laboratories.

Another question now being studied came to the Bureau because of its relations with the Underwriters' Laboratories. The Bureau cooperates with the Underwriters' Laboratories in some of its work, and had an agreement whereby appeals may be made to the Bureau in certain cases where the rulings of the laboratories are protested. The Underwriters' Laboratories is a private institution, but is performing a public function, and it is thought desirable that an appeal to a public body should be possible without resort to courts of law, especially since the questions at issue are usually of a scientific or engineering nature.

The first case under this arrangement to come to the Bureau was a joint appeal by the Underwriters' Laboratories and a manufacturer of renewable cartridge fuses, a device for protecting electric circuits. The Bureau is making a thorough investigation of various types of approved nonrenewable fuses as well as the renewable fuse under discussion, and is examining fuses as they are used. It is also conferring with insurance and municipal inspectors and engineers who have had experience with various types of inclosed fuses. Some of the experiments are being made in the Bureau's laboratories, and others in power stations where a large amount of power is available for the larger sizes of fuses. Some of these tests are to be made in conjunction with certain of the fuse manufacturers. When the question is decided and a report rendered, a full digest of the experiments and all the evidence gathered will be published, so that the public will be able to judge as to the merits of the question at issue. The case is of great importance to manufacturers and to the public.

Electrolysis Mitigation.

The majority portion of the street railways of the country are operated on the single overhead-trolley plan, with the electric current flowing into the rails through the car wheels, after it has passed through the car motors. The current then flows back to the generating station or substation by way of the tracks and earth, some of it, however, often flowing through underground gas and water pipes and

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the lead sheaths of underground telephone and electric light cables, and sometimes through reinforced concrete structures. The earth conducts electricity by virtue of its moisture and the salts dissolved in it, which renders it an electrolyte. Hence, when the electric current flows away from iron pipes or lead-cable sheaths, it carries away iron or lead by electrolytic action, and this in time corrodes the pipes and shortens their useful life and sometimes completely destroys them in a relatively short time.

The trouble is the more serious in places where the soil has a greater conductivity than usual, and where the conductance of the tracks is small in proportion to the current, and the distance the current travels back to the stations is relatively great. Many remedies have been proposed and tried, but no standard practice for the handling of the return current has ever been agreed upon in this country. As the electric railways have been extended and traffic has become heavier, the volume of current handled has increased very greatly, and the resulting destructive effects, which are cumulative with time, have become increasingly evident. In some cases litigation has resulted between the pipe-owning companies suffering damage and the railway companies whose current caused the trouble. But although the courts have considered the question of legal responsibility, these cases did very little to prevent the trouble in an effective and economical manner.

The Bureau has been studying the question for the past five years and has done a large amount of work in connection with it. This has included laboratory investigations concerning the effects of electric current on concrete and metal pipes, tests of pipe coverings, the corrosion of metals in the soil, methods of measuring soil resistance, and various other experimental phases of the work; methods of electrolysis mitigation that have been used or proposed and the results obtained; field studies in actual practice with the application of remedies and a determination of the cost and results obtained.

During the past year some additional work was done in St. Louis and Springfield (Ohio) and a very complete report prepared on the survey made at Springfield, Mass.

This survey was made at the invitation of the city of Springfield, and most of the public-utility companies of the city, including the gas, electric-light, telephone, and telegraph companies. The railway company did not unite in the invitation, but gave the engineers of the Bureau free access to its property and full information regarding its current, cables, and station operation. The cost of the survey and the report is borne in part by the Bureau and in part by the utilities. The object of the work is not merely to benefit Springfield, but to demonstrate the method of procedure in making electrolysis surveys, and in securing relief from electrolytic corrosion in an efficient and economical manner. A complete electrolysis survey was also made in Altoona, Pa., and a full report thereon submitted to the city and utility companies.

Another phase of the electrolysis work is the studying of the various methods of bonding rails at joints so as to provide good conductance for the electric current flowing through the rails. The three aspects of these joints which are most important are their permanence, their conductance, and their cost. A very thorough study of

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the subject has been made and a full report is being prepared for publication. In this work the Bureau has had the full cooperation of many of the electric railway companies and the manufacturers of rail bonds.

Still another phase of the subject is the question of roadbed resistance, since the amount of electric current flowing away from the tracks is reduced when the electric resistance from rails to earth is increased. In order to get definite information to aid the Bureau in making recommendations to railway companies, a number of sections of roadbed have been constructed on the Bureau grounds, and their resistance measured from time to time.

The work of the Bureau on electrolysis has been received most favorably by many railway officials and engineers, but very many still feel that it is a hardship to provide adequate conductors for the return current, having for so long been accustomed to turning it loose in the earth to return as best it could.

Lightning Protection.

A study of the protection of buildings against lightning has been in progress for several years, and a publication on the subject has been prepared, to be issued as Technologic Paper No. 56. This includes a full discussion of the methods of lightning protection, the results of experience as shown by vital statistics and the records of fire-insurance companies, and other interesting information. The work will be continued and specifications prepared for protecting different kinds of buildings so as to make it easier for architects and owners who wish to place lightning protectors on various types of structures to do so as efficiently and economically as possible. The Bureau has conferred with the manufacturers of lightning protection material and hopes to have their further cooperation in preparing specifications for protection systems. Additional papers prepared for publication during the year included Electrolysis and its Mitigations (Technologic Paper No. 52), Report on Electrolysis Conditions in Elyria, Ohio (Technologic Paper No. 54), and Report on Electrolysis Conditions in Springfield, Ohio (Technologic Paper No. 55).

National Electrical Safety Code.

The Bureau has been engaged for two years in the study of the life hazard in electrical practice and in the preparation of a national electrical safety code. In this work it has had the cordial cooperation and assistance of a large number of the ablest and most experienced engineers of the country, many of whom are connected with the electrical operating and manufacturing companies, and others are engineers and inspectors of State commissions and municipalities. The importance of having a national code, uniform in all the States, is quite as important for safety rules as for rules for reducing the fire hazard; and the advantage of having such a code prepared by an unbiased national agency that can study the subject thoroughly and consult all the interests affected is obvious. One of the four parts of the code, namely, the part containing the rules to be observed in the operation of electrical equipment and lines, was published as Bureau Circular No. 49 nearly a year ago and republished last May

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after revision with the cooperation of the National Electric Light Association and many electrical companies and engineers of commissions. The other three parts of the code, in preliminary form, were published as Bureau Circular No. 54 last April after several manuscript editions had been successively revised and rewritten. Representatives of the Bureau have held conferences in many cities on the subject, extending from Boston to San Francisco, and have collected an immense amount of information and criticism which is now being used in the revision of the code, preparatory to a second preliminary publication. In the near future there will be held in Washington a national conference on this code; delegates will attend from the various engineering societies, several of the State commissions, a number of the larger cities, insurance interests, the National Council of Safety, and a delegate from each of the groups of engineers with whom we have held conferences in the various cities. This will be a very representative gathering, and it will be asked to discuss, amend, and approve the national electrical safety code, which by the time it is presented for discussion will probably have undergone more thorough study and discussion than has any similar set of rules before being adopted by an administrative body.

National Gas Safety Code.

The Bureau is also engaged in the preparation of a national gas safety code, along the same general lines as the electrical code, and is receiving the cordial support of the gas industry. This work has been taken up more recently and has not progressed far enough to publish more than an outline. The safety code will consist of five parts, as follows:

1. The manufacture of gas.
2. The distribution of gas.
3. The design, construction and testing of gas appliances.
4. The piping of buildings and the installation of fixtures and appliances.
5. The use of gas and the care of appliances.

The first two parts of the rules will apply to the gas companies and their employees; the third to the manufacturers of gas appliances; the fourth to plumbers and gas fitters and the inspection department of cities; the fifth to the users of gas, domestic and industrial.

There can be no question as to the great need of such a safety code, and we have every reason to expect the fullest cooperation of all the interests affected in its preparation.

Telephony.

The Bureau has done comparatively little in the testing of telephone transmitting and receiving apparatus and switchboard equipment, but is now taking up this important work and hopes to develop it in an adequate manner. Telephone standards need to be fixed and facilities provided for making tests whenever required by cities or public service commissions, as well as when requested by telephone companies or by manufacturers of telephone apparatus and equipment.

On the plea of public convenience and necessity for interchange of service, petitions for physical connection between telephone sys-

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tems under different ownership, whether operated in different localities or in the same locality, and even cases involving the connection between intercommunicating systems in hotels, business establishments, etc., with one or both local operating companies, are being brought before public service commissions with increasing frequency. One of the questions involved is whether, if such physical connections were granted, the transmission of speech between telephones of the two systems would or would not be impaired by such connections in comparison with the transmission between two telephones of the same system. This question, as well as the more general question of what is proper and adequate service under given conditions, and many others, are susceptible of experimental study, and the representatives of the public should have facilities for such tests available, and competent and experienced persons to make the tests.

The Bureau will cooperate with manufacturing and operating telephone companies and telephone associations, as well as with State commissions and city officials, in this as in other public-utility work.

Relation of the Bureau to Municipalities and Public-Service Commissions.

In some States there are no public-service commissions to issue regulations or inspect the quality and safety of the service rendered by the various utilities. In some other States the railroad or public-service commissions have taken no action in the matter, although having authority to do so. In either case the cities and towns must look after their own interests, and frequently have taken up the matter with enterprise and understanding. Where there are well-equipped and active State commissions, which have adopted rules and are ready to hear complaints regarding rates or service, still a very large responsibility rests even in such cases upon the municipalities. Few State commissions will ever be likely to have a force of engineers and inspectors large enough to enable them to take the initiative in each case, and relieve the municipalities of all responsibility. On the contrary, if the municipalities are active and enterprising in their own behalf, and the larger ones have well-equipped public-utility departments, which can prepare the city's complaints or requests and take them up to the State commission for hearing and adjudication, the State commission would be better able to serve all the municipalities of the State, and the municipalities would enjoy in large measure the advantages as well as the responsibilities of home rule, without its greatest disadvantages.

But for most cities it is a difficult matter to judge as to the quality of service rendered by its utilities. The studies made by the Bureau of Standards have been directed toward simplifying this problem by providing well-defined specifications of what constitutes good service, and the Bureau has a considerable correspondence with commissions and cities on this subject. The resources of the Bureau, however, are not sufficient to enable it to do as much as ought to be done, and some of the most important subjects in this connection have not been taken up at all.

It will obviously never be practicable for any State commission or city to handle these questions alone. Though they possess large and able engineering staffs or employ specialists for each separate problem, the question of what is good service or whether the service in

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any given case is adequate, safe, and satisfactory can only be settled by reference to what is done under similar circumstances elsewhere in the country. In other words, standards of good practice and good service are largely determined by general experience, and should be studied comparatively in a large way. One method of doing it is for the States and cities to get together and establish a special bureau or institution for the purpose, the several States and cities paying for any service derived therefrom. The new Utilities Bureau of Philadelphia is such an institution, and there is ample field for its activities. But it has appeared very desirable for a bureau of the Federal Government to do a certain portion of the work; hence, the Bureau of Standards has been doing this in a somewhat experimental way to test the desirability and acceptability of the method. The success and approval which the work has met so far seem to justify its expansion.

Necessity for Increasing the Public-Utility Work of the Bureau.

The sum available for the public-utility work of the Bureau, including a special appropriation for the safety work, is $40,000 per year, and allowing for the supervision and assistance rendered from the general funds it may be considered as $50,000 per year. Many of the States spend more than this, and some States five or ten times as much. The people of the United States spend about two billion dollars a year for the service of the public utilities, or $20 per capita per annum. This includes the telephone, gas, electric light and power, electric railway transportation, and miscellaneous utilities, not including the steam railways. The States through their public-utility and railroad commissions spend four million dollars a year regulating the utilities and railroads, and the cities a large amount in addition. A considerable sum could profitably be spent annually in an efficiently conducted cooperative study of the conduct of such utilities, defining standards of service, preparing safety rules, assisting in local studies as to service, acting as referee or adviser in cases of dispute, serving as a clearing house of information on all public-utility and associated engineering questions, helping to secure uniform methods of accounting where public-service commissions are not yet established, carrying out laboratory tests and investigations to answer difficult questions, and making it possible for rules as to service and safety to be kept revised up to date, after they have once been formulated and adopted. Such work carried on with the cooperation of the utility companies requires a great many conferences and discussions, and the harmonizing of differences of opinion. Many such differences of opinion are due to lack of precise information. Often experimental or other studies clear up such differences and bring about uniformity of practice. A Federal bureau well equipped with men and apparatus, and permitted to work in the very wide field of public utilities (outside of railroad transportation and such subjects as the Interstate Commerce Commission is concerned with), would accomplish great good for the public. It does not appear to be overestimating the value of such work to say that an average benefit equivalent to 5 per cent of the sum now paid for the service would result. It seems conservative

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to suppose that such benefit, in improved efficiency and better service, would seldom be less than 2 or 3 per cent, and sometimes as high as 10 per cent. Five per cent of $2,000,000,000 is $100,000,000 per year, and this is a reasonable estimate of the possible value of the service we are considering, assuming such service to be efficient and ample. One cent a year per capita does not seem too much for the people to spend through the Federal Government to accomplish this result. At present the Bureau of Standards is spending one-twentieth of this, and has accomplished enough to show how valuable such work is. If the funds available for this work could be gradually increased as the work develops until each person in the country was contributing, say, only one-fourth of a cent per year, and the total was one-fourth of a million dollars, the sum would still be less than several of the larger States are spending alone, and yet the results of the work being made available for every State would yield in the aggregate a large return to the people. Considering the enormous cost of public-utility service, it does not appear to be desirable to continue spending so much without a greater effort to derive the benefits possible from a just and adequate system of public-utility regulation.

But the money value of proper regulation of the utilities is not the only benefit to be derived therefrom. The increase of safety and reduction of accidents is another consideration difficult to estimate in dollars and cents. Still another advantage more difficult to appraise but not difficult to appreciate is the favorable influence on State and municipal government. Unregulated utilities sometimes control municipalities; improperly regulated utilities are sometimes forced to resort to questionable methods in self-defense. Public officials charged with the duty of regulating public utilities, but not provided with means of doing it equitably and effectively, are almost helpless.

4. OPTICS.

Determination of Standard Light Wave Lengths.

The determination of standard wave lengths has been continued throughout the year. The growing importance of spectroscopic analysis adds importance to this work and the need of standard wave lengths will be illustrated in the following paragraphs. During the year 131 standard wave lengths in the iron spectrum were published in Scientific Paper No. 251. The region covered in this publication extends from wave length 2,850 A to 3,700 A, all in the ultra-violet (1 A=0.0000001 mm.). The work on the visible portion of the iron spectrum is well under way and will soon be ready for publication. Owing to their extreme sensitiveness to red and infrared, photographic plates which are prepared at the Bureau will enable us to carry these investigations far into the infrared.

The prosecution of this piece of research necessitated the installation of a concave grating, apparatus for sensitizing photographic plates, apparatus for depositing metallic films cathodically, and the addition of considerable other laboratory equipment. Aside from supplying half-silvered mirrors for interference work, the cathodic apparatus has been useful in coating galvanometer mirrors with

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platinum, and in plating mica with platinum for constructing a special condenser. Another by-product of this research was the determination of certain wave lengths in the neon spectrum. (See Scientific Paper No. 251.)

Information Furnished on Spectroscopic Subjects.

The spectroscopic information furnished to Government bureaus and to firms and individuals has been of quite a varied nature. In most instances this information could be given at once, but in the following cases some investigation was necessary. A suitable source for violet and ultra-violet light was found for the Bureau of Chemistry. The detection of minute quantities of impurities in ammonia by spectroscopic means was investigated at the request of the division of chemistry. The purity of electrolytic iron was investigated for the metallurgical division. This investigation led to the correct indentification of certain lines in the iron spectrum which are due to impurities. It also showed the extreme difficulty of obtaining iron entirely free from manganese, copper, and silicon.

Investigation of Vacuum Tubes of the Rare Gases.

For this investigation quartz vacuum tubes with sealed-in electrodes were furnished by the Cooper-Hewitt Electric Co., and filled either at this Bureau or by Sir W. Ramsey. The investigation showed that the spectra of these gases have not been determined with sufficient care, and a more extensive study of these spectra will be necessary before the purity of the gases can be proven. It is certain that Xenon is seldom, if ever, free from Krypton, and, conversely, Krypton probably contains Xenon.

Quantitative Spectroscopic Analysis of Steel.

This subject was investigated at the request of various manufacturers of steel. At present, in the judgment of the majority of eminent spectroscopists, the quantitative spectroscopic analysis of steel can be made only by an experienced observer at the expense of great labor and the exercise of much patience. An attempt has been made to bring the subject within the scope of the average analytical chemist and to increase the accuracy of the results. The results to date are quite encouraging. The preliminary work is rather large, but once it has been done the labor of analysis is not great. Consider a single simple example, the estimation of the chromium content of a low-carbon steel. Leaving the other constituents of the steel essentially in the same proportions, samples are made up, or selected from stock, having a chromium content of 0.02 to 4.00 per cent, each sample having about 25 per cent more chromium than the one before. The spectrum of each of these samples is photographed, and the comparison of a photograph of the spectrum of the unknown with this series permits an estimation of the chromium content to be made with some accuracy. In the case of the elements niobium and molybdenum, the estimation of small quantities by spectroscopic means is more reliable than the chemical analysis. In general, the spectroscopic rivals the chemical analysis wherever the element in question is present in quantities less than 5 parts in 10,000.

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Spectroscopic Analysis of an Alloy which is Liquid at Room Temperatures.

This unique alloy was sent to the Bureau for analysis. The chemical analysis proved to be very difficult and a spectroscopic examination was made at the request of the chemical division. The sample was found to consist of gallium, indium, and zinc. It contained no mercury nor cadmium. In the course of the investigation, the spectra of the rare elements gallium and indium were found to be incorrectly determined and a redetermination, using purer material than has been hitherto employed, is greatly to be desired.

Spectroscopic Tests.

The ultra-violet transmission of two absorption cells was determined for the Weather Bureau. The performance of a spectroscope was investigated for the Bureau of Chemistry. Tests of the ultra-violet transmission of samples of glass have been made for various manufacturing firms.

Standardization of Industrial Sugar Testing.

The absence of standardized methods of testing sugars and sugar products has long been a handicap to the industry. The values of the materials tested make it necessary to secure the most accurate tests possible. Owing to the lack of a central standardizing bureau in the Western Hemisphere, the industrial concerns were for many years thrown entirely upon their own resources to obtain methods of testing. Hence, a diversity of methods of testing existed, not only among the companies doing business in the United States, but also between this and other countries with which the United States does a large import business. The Bureau has, therefore, increased its efforts toward securing the adoption of standardized methods where experts are in disagreement as to the best methods, and then to make these standardized methods available to Central and South American countries. Circular No. 44, on Polarimetry, has been issued. The interest aroused is shown by the demand for this publication, not only from this country, but also from all parts of the world. The first edition was soon exhausted and the work of revising for a new and more complete edition is now in progress.

Conference of Polarimetric Experts.

The work of obtaining standardized methods of sugar testing would be greatly facilitated by calling a conference of the scientists interested. It has been suggested that if such a conference could be brought about it would be possible to secure an agreement on important methods which have long been in dispute. The Bureau hopes to take the initiative in this matter during the coming year.

Constants of the Saccharimeter.

Several years ago an investigation of the reading of chemically pure sugar on the scale of the saccharimeter (a polariscope for testing sugars) was undertaken. This is of fundamental importance, since this reading fixes the 100-degree point of the sugar scale in terms of which the purities of other sugars are determined. The 100-degree

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point now used by the Bureau for standardization purposes and by the greater portion of the sugar world was determined by European Governments. The Bureau's investigation shows that this constant is too high by over one-tenth of 1 per cent, a relatively large error. The loss to our Government in duties that should have been collected on imported sugars amounts to over $50,000 a year and the producers of raw sugars have received less compensation than they should have received.

The importance of the issue as brought forward by the Bureau's investigation was recognized by the International Sugar Commission by appointing an international commission with one member from each of three countries—the United States, Germany, and Austria. A member of the Bureau was appointed chairman. Owing to the present conditions abroad, no cooperative work has so far been attempted. The Bureau's investigation has, however, been extended and new values have been obtained for a number of other constants which are dependent on the 100-degree point of the saccharimeter and which are of great importance to the sugar industry, and for scientific purposes. Out of this new work has come additional evidence which strengthens the Bureau's position on the question of the error in the 100-degree point. The necessity for a common basis of testing to be agreed upon by the leading nations is of such importance that the Bureau is still testing all apparatus and the Treasury Department is still collecting the revenue on sugar, on the basis given by the old value of the 100-degree point. It is hoped that a change to the new and correct value can soon be made.

The Specific Rotation of Pure Sugar.

Perhaps the most important of the physical constants of pure sugar (sucrose) is its specific rotation; that is, the rotation of the plane of polarized light by a solution containing unit weight in unit volume. This constant expressed in circular degrees has been studied for many years by the various countries interested. Because of the high purity of the sugar and the precision of measurement required in the research on the constants of the saccharimeter already referred to, advantage was taken of the opportunity to obtain a very accurate determination of the specific rotation. The value secured for sodium light was 66°.529 at 20° C.

The Rotation Dispersion of Sucrose (Cane Sugar).

The amount of the rotation of the plane of polarized light by pure sugar is different for different colors. This variation has not been studied for many years. A more accurate knowledge of these phenomena is required by manufacturers if further advancement in saccharimeter design is to be made. Preliminary measurements have been made and they show a disagreement with the results obtained by previous investigators.

Pure and Intense Light Sources for Polarization Work.

The attempt to measure accurately the rotations of sugar for different wave lengths (colors) of light has necessitated further study of the problem of obtaining pure and intense sources of light. This is perhaps the most troublesome problem in polarimetric work. Never-

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theless, considerable progress was made during the year. A burner for either sodium or lithium has been perfected, and improvements made in the rotating cadmium-silver arc. These, together with the quartz mercury vapor lamp, are capable of giving intense light of various wave lengths fairly uniformly distributed throughout the visible spectrum.

In addition some time has been spent on the study of dispersive systems for producing pure light of high intensity with a view to finding more suitable dispersive materials, but this work has suffered on account of the scarcity of optical glasses due to conditions abroad.

Referee Work upon Molasses Testing.

The use of the exhausted molasses from the manufacture of cane sugar for road making, cattle feeding, and distilling purposes is steadily increasing. Only a few years ago this by-product was in many instances thrown into the sea in order to get it out of the way. It is now being shipped to this country in large quantities. The distillers especially are dependent upon it for the preparation of alcohol and alcoholic products by the fermentation of the sugar contained. The molasses is sold on the basis of its total sugar content and to determine this has never ceased being a problem to both buyer and seller. In order to obtain the total sugar, it is necessary to determine not only the sucrose, but also the invert sugar or "glucose" and any other varieties of sugar which may be present. The appraisal of the molasses is based upon the analyses of buyer and seller and a third analyst who acts as a referee. The continued disagreement between the results of the different analysts finally resulted in the Bureau being requested to act in the capacity of referee, and, furthermore, to advise in the selection of suitable analytical methods. It was found that among the methods in vogue are some which although recommended by apparently reliable authorities are seriously at fault. The inherent difficulty of the test as well as the need of selecting the proper methods of procedure will require considerable investigation. This work has progressed satisfactorily and in the meantime the Bureau has made the referee tests on the samples from a number of importations.

The Optical Rotation of Dextrose (Grape Sugar or Glucose).

Dextrose or glucose, sugars of which grape sugar is an example, is a substance widely distributed in nature but is nowhere to be obtained in a pure state. Inasmuch as the analysis of materials containing it depends upon a knowledge of the properties of the pure dextrose, much effort has been spent in purifying the substance and investigating its properties. The investigation of its optical rotation upon the saccharimeter which permits the use of white light sources, and upon the polarimeter, which requires monochromatic sources, has been continued and will be available for publication during the current year. One manufacturing firm has written to the Bureau for information upon this problem. The substance is also available as a standard for controlling the analysis of reducing sugars, a large class of sugars not including sucrose, which are analyzed by their chemical effect upon copper in alkaline solution.

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The Optical Rotation of Levulose (Fruit Sugar).

Levulose or "fruit sugar" is of wide occurrence, but, like dextrose, is never found in a pure state. The work of preparation and purification has been continued and a few preliminary measurements made. Inasmuch as the rotation of this substance is particularly susceptible to changes of temperature, apparatus has been constructed to control the latter very precisely during the polarization. This apparatus has also been of use in the work upon molasses, which also demands precise temperature control.

Samples of Standard Sugars.

The work of preparing and issuing standard samples of sucrose and dextrose to be used in the standardization of saccharimeters and for standards of combustion has been continued, owing to the constantly increasing demand by manufacturers and scientists for these materials. A total of 91 standard samples of the sucrose and dextrose were issued during the year. This is an increase of about 50 per cent over the preceding year.

Oven for Vacuum Work.

A high-temperature electric oven has been designed and built for use in the preparation of vacuum apparatus, such as quartz mercury vapor lamps, which it is necessary to raise to a high temperature during the process of evacuation. It is believed that the prolonged heating which is now possible will also eliminate the moisture from the vapor lamps used largely in many kinds of physical investigations.

Magnetic Field of Optical Magnet.

In studying the rotation of the plane of light waves which occurs when many substances are subjected to the presence of a magnetic field, it has been found necessary to know the exact distribution of force in the field produced by the Bureau's large electromagnet.

A preliminary study has been made under various working conditions (different pole pieces, different distances between the pole pieces, different current strengths, etc.). The field of force along the axis of the pole pieces has been explored with a bismuth spiral (a device for measuring the strength of a magnet field), and the intensities plotted against the distance from the center of the field. Curves have also been plotted showing the magnitude of the change in the field strength caused by varying the distance between the pole pieces and also by varying the current strength.

Supervision of the Customs Service Laboratories.

The important work of supervising the Treasury Department's sugar-testing laboratories has been continued. The results obtained by increasing the accuracy of the work have been highly gratifying. A mechanical system for controlling both the humidity and the temperature of the air has been installed in the New York laboratory and a series of comparative sugar tests will be made simultaneously with the Bureau's laboratory. The data secured by these tests should be of great value and it is hoped will settle several vexatious questions regarding the necessity for temperature control in routine sugar testing. Additional assistance has also been rendered the

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Treasury Department with the object of making needed improvements in the equipment, personnel, and efficiency of its general customs laboratories.

Polarimetric Tests of Raw Sugars and Molasses.

During the year 1,257 samples of raw sugars were tested. The samples were mainly from the large ports of entry and the results were used to check the accuracy of the customs laboratories. A number of samples of molasses were tested, the nature of the test and the amount of work performed depending on the conditions under which the sample was submitted.

Miscellaneous Polarimetric Testing.

A number of very pure samples of turpentines have been submitted to the Bureau and their natural and magneto-optical rotations determined. It is hoped the data will aid in the identification of turpentines. Other routine tests were made, such as polariscopes, quartz control plates, and cover glasses for polariscope tubes.

Polariscope Tubes for Sugar Testing.

Practically no polariscopic apparatus is manufactured in the United States. In an effort to make a beginning at overcoming this very undesirable condition, the Bureau has designed a polariscope tube. These tubes are used to contain the sugar solution while it is being read in the polariscope. The best European-made tubes are expensive, there is always delay in obtaining them, and they are inadequate in strength and scientific design. After an experimental tube had been perfected at the Bureau, an American firm succeeded in reproducing it so satisfactorily that the number of failures when subjected to testing were less than the foreign-made tubes. The Treasury Department has purchased these tubes in large numbers and they are now on the general market, where they are fast displacing the imported article. There has thus been made available to the American sugar industry a polariscope tube that is superior in design, more durable, more costly to manufacture, and yet less expensive than the European tube. Owing to the present difficulty of securing apparatus from abroad, the sugar industry is suffering from a lack of polariscopic apparatus, with the single exception of polariscope tubes. The Bureau hopes to succeed in establishing the manufacture of all polariscopic apparatus in this country.

Color Standards and Color Specification.

The need of scientifically valid and at the same time practicable methods of specifying the color of materials is urgent in many industries as well as in scientific investigations. The demands made on the Bureau for colorimetric tests and for information and advice relative to color standards and color specification are frequent and persistent and come from sources having such diverse interests as manufacturers, dealers, engineers, psychologists, opthamologists, dairymen, biologists, chemists, and those who for lack of a better term may be called the general public. For example, such requests have been received from the Navy Department, the Weather Bureau, the Bureau of Chemistry, the Pennsylvania Railroad Co., the Automobile Club

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of America, the National Dairy Union, the Society of Cotton Products Analysts, the Bellevue Hospital of New York City, the Eugenics Record Office, and various manufacturers, consulting engineers, and scientific investigators. The Bureau's correspondence shows that our correspondents are interested in specifying the color of such substances as glass (signals, headlights, spectacles for eye protection), petroleum oil, cotton-seed oil, turpentine, rosin, paper, textiles (materials for uniforms, silks and felts for organization insignia, etc.), eggshells, egg yolks, butter, oleomargarine, dyes, water (as an index of purity), solutions of various chemicals, portland cement, tobacco, porcelain, flour, blood, and the human skin.

In many cases the need of reliable color specification is due to purely commercial causes. The price of the commodity (cottonseed oil, for example) is determined by its color and a dispute as to correct grading is a matter of dollars and cents between the buyer and seller. In such cases the need of authoritative standards and methods of measurement is keenly felt by dealers whose interests are involved. On the other hand, there is also pronounced need of color standards and methods of specification in various scientific investigations and researches in physics, chemistry, biology, and psychology, where the interest is often purely scientific and academic. Finally, in still other cases color specification is a matter involving personal and public safety, as in the instance of colored glass for eye protection, railway and marine signal glasses, etc.

In response to many of these varied demands during the year, the Bureau has been able to perform tests and afford information and advice as requested. On the other hand, owing either to lack of assistance or to the undeveloped nature of the subject, it has been impossible to conform to others. It will doubtless be possible to deal satisfactorily with many of these latter cases at some future time, and the applicants have been so informed. In this connection, it may be pointed out that, compared with many other divisions of the Bureau's work, this subject is new and unstandardized, being now in the formative stage. Much of the current work is, therefore, of a preliminary and tentative nature. Assumptions must be tested; fundamental facts must be established by painstaking research; new instruments must be designed and constructed; and methods of measurement must be devised, tested, and systematized. The important thing in this division now is to lay secure foundations for the future, but, as is shown in this report (see below), the current demands of the public are largely met, although not in as complete and satisfactory a manner as is desirable. The demands made on the Bureau for this kind of work would seem to justify the appropriation of a special fund to be used in putting it on a more satisfactory basis.

In the following paragraphs report is made on particular features of the year's work in regard to color specification, color standards, and color grading.

Spectrophotometry.

The fundamental physical basis of color specification is spectrophotometry. Daylight is a mixture of many colored lights of all hues—red, orange, yellow, green, blue, violet, and their transition steps. For the sake of definiteness and accuracy in the subject, a

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colored light is specified by its wave length rather than by a color name. A transparent substance which transmits light of certain wave length more freely than others will generally appear colored, the exact hue and tint being determined by the relative transmission for the different wave lengths, while the shade is determined by the total transmission. The task of spectrophotometry in this connection is to determine the transmission (ratio of transmitted light to incident light) for each wave length separately. The instrument for making such determinations is called a spectrophotometer, being a combination of spectrometer (instrument for measuring wave length) and photometer (instrument for measuring light intensity). An accurate specification of spectral transmission (relative transmission for the different wave lengths) constitutes a complete and certain specification of color, as a property of the substance.

During the year progress in spectrophotometry has been made in the following particulars:

Routine experimental methods have been improved and simplified in a way to increase convenience and insure reliability.

By the design of a special slide rule a saving of about 50 per cent in time of computing results has been accomplished with an accompanying increase in convenience and reduction of mental fatigue.

The wave-length scale of the spectrophotometer has been recalibrated by a method independent of that used in its original calibration in 1913, and the first calibration closely verified.

Several satisfactory intercomparisons and countercheck experiments have been carried through in order to test the reliability and accuracy of the methods used.

In order to have at hand a supply of color screens of known properties, the spectral transmission of a number of selected marked glass samples has been determined and the samples and data systematically filed for future reference.

Although a great amount of work remains to be done and is outlined for the future, the spectrophotometric work is now considered to be well established and in good order. During the year reports on spectrophotometric tests or investigations have been made for the Pennsylvania Railroad Co., the Automobile Club of America, Corning Glass Works, Society of Cotton Products Analysts, Florida Cotton Oil Co., National Dairy Union, Bureau of Chemistry, Weather Bureau, and for Mr. Basset Jones, illuminating engineer. Tests were also made for the photometric division of the Bureau of Standards, and the Bureau of Plant Industry was afforded facilities and assistance in a spectrophotometric investigation of certain solutions of interest in the study of chestnut blight. Detailed instructions for calibrating the wave-length scale of the König-Martens spectrophotometer were supplied by request to the United States Food and Drug Laboratory, New York City. Owing to lack of sufficient assistance, it has now become necessary to decline some routine spectrophotometric tests and refer the applicants to private testing laboratories.

Color Specification by Means of the Rotatory Dispersion of Quartz.

The many colored constituents of white light may be separated and recombined in varying proportions by means of a property of

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crystalline quartz known as rotatory dispersion. On this principle there is constructed a colorimeter known as the quartz colorimeter. Considerable time has been spent in critical study of this instrument in the attempt to better adapt it to practical use. This work is still in progress. A by-product of this study has been the suggestion of a novel method of comparing the candlepowers of lights of different colors. This proposed method was definitely outlined by a member of the Bureau staff at the meeting of the American Physical Society in April, 1915.

Color of Cottonseed Oil.

The investigation of the color of cottonseed oil mentioned in previous reports has been continued, although it has been greatly handicapped for lack of assistance. Progress has been made in the following particulars:

The spectral transmission (see paragraph on "Spectrophotometry") of a number of authentic samples of oil has been determined.

The relative transmission for blue and yellow has been determined (by means of a photometer and selected color glasses) for a number of samples and the results considered as a function of color graded by other methods. The determination of this relative transmission may prove to be a satisfactory and practicable means of grading the oil.

The permanency of the color under different conditions has been studied. It is commonly known that the color is very fugitive when exposed to light and air and that it fades more slowly in the dark. Experiments this year have shown that the color is very permanent even when exposed to direct sunlight, provided all air has been removed and the oil is kept sealed in vacuo. The establishment of this fact is important as indicating the possibility of preserving standard samples.

The color of samples of oil in different thicknesses has been read on the Aron's chromoscope (a type of quartz colorimeter) to show the relation between thickness and the scale readings of this instrument.

By invitation, the Bureau's expert in charge of this investigation made a report on it at the Annual Convention of the Society of Cotton Products Analysts, Birmingham, Ala., in May, 1915, and this report is being published in the Proceedings of that society.

Desiring to expedite this investigation and have it prosecuted more rapidly than the Bureau's resources would permit, the Society of Cotton Products Analysts and the Interstate Cotton Seed Crushers' Association have provided about $1,700 to pay salaries of assistants to carry on this investigation under the direction of this Bureau. Accordingly, at the close of the year plans were adopted for the conduct of such an investigation in the Bureau's laboratories. An assistant was selected and the work under this arrangement is now well under way.

Method of Specifying a Color Limit for Oleomargarine.

At the request of the National Dairy Union, the Bureau has devised a method for specifying a color limit for oleomargarine. The inception of this method was mentioned in last year's report. During the past year it has been developed and perfected and more thoroughly tried out. This form of specification is believed to be practicable as well as scientifically valid. The essential feature of

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the method is the specification of the color limit in terms of the relative reflecting power for blue and yellow. For the sake of definiteness and precision, the wave lengths of the blue and yellow are specified. The specification then reads: The *diffuse reflecting power for light of wave length 436 micromillimeters (blue) shall not be less than — per cent of the diffuse reflecting power for light of wave length 578 micromillimeters (yellow), the temperature of the sample being 70° F.* The Bureau has designed and constructed a suitable apparatus for measuring the ratio herein specified. This form of specification was recommended to the National Dairy Union at its conference at the Bureau June 2, 1915; and that organization has adopted it, inserting "70" in the blank space before "per cent."

Investigation of Proposed Rosin Color Standards.

As mentioned in the report for 1914, a comparison of the colors of natural rosins with their proposed glass standards for rosin colors had been undertaken at the request of the Bureau of Chemistry, Department of Agriculture, and was in progress at the close of the fiscal year 1914. Final report on this investigation was made to the Bureau of Chemistry on November 27, 1914. It summarized the following conclusions:

1. The proposed glass standards do not match the same nominal rosin grades (present trade standards) submitted. Some, indeed, more nearly match other grades. The proposed standards are generally (with one or two exceptions) paler than the present rosin trade standards submitted.
2. The relative transmission for light of different colors is not the same for the proposed standards as for the natural rosin. This is an undesirable characteristic.
3. The color intervals between successive grades of the proposed standards are not of uniform value.

Establishment of a Standard Method for Testing the Transparency of Tracing Cloth.

The necessity of measuring in some way the transparency of tracing cloth and semitransparent papers has been brought to the Bureau's attention by the request of the Treasury Department, Navy Department, Post Office Department, and several manufacturers and dealers. In order to bring about uniformity and a general understanding among all interested parties, it has been necessary to formulate a standard method of test. The Bureau's method which has been used in a tentative way for two or three years previously has now been perfected and definitely adopted as a standard routine test method. A circular statement was issued in February, 1915, and sent to interested parties; and the method as outlined therein has been approved by several qualified experts outside of the Bureau. The Navy Department, which formerly had a specification of its own, has signified its intention of writing future specifications in terms of this method of test.

The essential feature of the method is the measurement of the contrast between perfect black and perfect white as seen through the tracing cloth. The Bureau has designed and constructed suitable apparatus for making this measurement.

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The American Ceramic Society has also become interested in this method as affording a means of measuring the translucency of porcelain. By invitation the Bureau's expert on this subject described the method to that society at its annual convention at Detroit in February, 1915, and his paper is being published in the Transactions of that society.

Study of Method of Measuring the Turbidity of Spinal Fluids.

At the request of the Psychiatric Institute of the State Hospitals of New York, a study of the turbidimeter was made to determine its usefulness in measuring the turbidity of spinal fluids. The study of this serum is of importance in the diagnosis of diseases of the brain. The results obtained with the preliminary instrument show that it is entirely applicable, and a representative of the Bureau has assisted the institute in designing apparatus to be used in this work.

Study of the Properties of Fog at Sea.

The great influence of fog upon the safety of vessels at sea makes a scientific investigation of fog desirable.

A preliminary investigation of the properties of fog at sea was made in cooperation with the ice patrol of the Coast Guard on the May cruise of the *Seneca*. A study was made of the number of nuclei present in the sea atmosphere. Nuclei are small "dust particles," always present in the air, upon which the water vapor condenses. The number of these condensation nuclei, or the nucleation, is a most important characteristic of the atmosphere in relation to fog. The amount of liquid in the fog particles was also studied.

Information Furnished on Optical Subjects.

Information relative to such subjects as color specification, transparency, translucency, turbidity, and interferometry (methods of measurement in terms of the wave length of light) has been supplied on request to many applicants, sometimes by correspondence and again by personal conference. Among those served in this way were the Navy Department, the Department of Agriculture, the Pennsylvania Railroad Co., the General Electric Co., the Waltham Watch Co., the A. D. Little Co., of Boston, Bellevue Hospital, of New York City, and others.

Investigation of the Commonly Found Errors in Photographic Lenses.

Methods have been developed for the measurement of the errors which interfere with good definition near the center of the field of view. Measurements have been made on the principal types of commercial lenses for four different colors and for zones extending from the center to the edge of the lens.

This investigation in conjunction with previous ones gives a numerical measurement of the quality of a lens. The results of this investigation are being prepared for publication.

Speeds of Photographic Shutters.

Preliminary determinations of the speeds of photographic shutters have shown that many shutters are erroneously marked and, there-

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fore, an investigation of their speeds and efficiencies has been started. As an example, several shutters gave an almost uniform speed of 1/40^s when set at 1/25^s, 1/50^s and 1/100^s.

Standard Lenses for Opticians' Trial Sets.

An investigation of the methods of standardization of opticians' trial sets is being carried out in order to eliminate some of the endless confusion arising from the numerous errors in trial set standards. Two sets submitted by one of the leading manufacturers are now being standardized and will be used by them as primary standards.

Testing Optical Systems.

The testing of optical systems has been done largely for the different departments of the Government. These tests embrace various types of optical instruments, including photographic lenses, searchlight mirrors, binoculars, telescopes, projection lenses, submarine periscopes, and gun sights.

A marked increase in light transmission of certain optical instruments has been noted since last year. In some cases this increase is more than 40 per cent.

Refractive Indices.

The extent to which light is deviated from a direct course when passing through a transparent substance is defined as the refractive index of the substance.

Refractive index determinations have been made of glass and various materials as requested for tests. Also some standard test plates have been furnished to manufacturers for calibration of their instruments for measuring refractive indices.

Information Furnished as to Optical Instruments.

Many requests have been received for information and advice concerning optical instruments.

A comparative investigation of the optical parts of motion-picture machines was made for the purpose of selecting the most suitable machine from those submitted as samples in connection with the purchase of such machines by one of the departments.

Many have applied for advice regarding the practicability of projected optical systems, and much assistance has been rendered in this direction. Simple formulæ for spectacle lenses free from astigmatism for oblique rays were developed, at the request of one optical firm.

Considerable time has been devoted to consultation work with the various departments of the Government, as well as with the different divisions of this Bureau with reference to the design, specification, testing, and use of optical systems. Also, data have been furnished which enabled some optical systems to be repaired in this country where formerly repair parts could only be obtained abroad.

Radiometry.

In many physical, chemical, and physiological investigations it is of great importance to know the behavior of substances when subjected to stimuli of radiant power, light, and heat rays; that is, radiant energy of all wave lengths, whether visible or invisible to

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the eye. During the past year the Bureau has continued its investigation in connection with the improvement of instruments for measuring radiant energy, especially instruments for measuring radiant energy in absolute value. Important advances were made in shielding the galvanometer from external magnetic disturbances and thereby improving the reliability of the radiometric measurements.

The design of galvanometer coils was also investigated. Coils wound in 1, 2, or 3 sections of graded wire were compared with a set of three standard coils, and the magnetic force exerted by them was thus determined. As a result of this investigation, a coil, wound empirically with a single grade of wire, was found which is as efficient as a coil wound according to theory and having three sections of graded wire. Furthermore, a coil which was empirically wound was found which was about 20 per cent more efficient than a coil having the same resistance but wound according to theory. In addition to magnetic shielding and the design of the coils, further attempts in improving the galvanometer are in progress. The results of this investigation are ready for publication.

Nocturnal Radiation Measurements.

Nocturnal radiation is usually a loss of heat from terrestrial substances into space. This has a profound influence upon terrestrial temperatures and, hence, upon vegetation. During the past year instruments were constructed for the United States Weather Bureau for investigating this loss of radiation into space, the direct practical application being the question of the cause of frosts upon certain mountain sides which are covered with fruit trees.

Radiometric Outfit for Physiological Work.

Radiometric instruments, including galvanometer, thermopile, etc., are in the process of construction for the United States Public Health Service. This apparatus is to be used in measuring light stimuli in connection with investigations of vocational diseases.

Glasses Which are Opaque to Infra-Red Rays.

There has been considerable agitation of the question of the protection of the eyes of workmen exposed to the intense infra-red radiations from red-hot furnaces and from the intense luminous radiations from arc lamps, etc. Glass manufacturers are actively engaged in the production of spectacle glasses which absorb all the infra-red rays, but have a high transmission in the visible spectrum. During the past six years and especially during the past year various glasses have been examined for their transparency in the infra-red, and from the results obtained the Bureau is in a position to give authoritative information relative to general cases of eye protection by means of colored glasses.

In this connection, it is relevant to repeat the statement made in last year's report regarding the necessity of carrying on investigations of the properties of materials, even though the immediate practical application of the data may not be apparent. In that report cases were cited where the data obtained did not appear to have immediate application. The present case of the application of data, obtained some years ago, on the transmission of colored glasses is a

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further illustration of the importance of carrying on investigations of the properties of materials, even though an immediate application can not be made of the data so obtained.

The Stefan-Boltzmann Constant.

The coefficient of total radiation from a perfectly radiating body, commonly called the Stefan-Boltzmann constant, was thoroughly investigated during the past year by means of an improved radiometer applicable for evaluating radiant energy in absolute measure. The investigation was made under various conditions as to atmospheric humidity, blackness of the radiator, different kinds of receivers, etc. The value of the coefficient of total radiation as determined by this method is $\sigma=5.74\times10^{-12}$ watt cm^{-2} deg^{-4}. The investigations made during the past twenty years, using different methods, were subjected to rigorous analysis. Corrections were made for atmospheric absorption, and it was then found that all the reliable investigations give values which are close to $\sigma=5.7$. The data obtained in this investigation have been assembled into a paper which is ready for publication. The first part of this paper deals with instruments for evaluating radiant power in absolute measure; the second part of the paper gives an analysis of all the data available on the coefficient of total radiation, as well as subsidiary data on atmospheric absorption, etc.

Measurements on the Radiation from Stars.

During the past 47 years numerous attempts have been made to measure the heat received from stars. In last year's report attention was called to the perfection of a minute thermocouple of bismuth-platinum in a vacuum maintained by means of metallic calcium. During the past year a number of these stellar thermocouples were compared in the laboratory and also in connection with a 3-foot reflecting telescope at the Lick Observatory, Mount Hamilton, Cal. The instruments proved to be satisfactory. Measurements were made on 112 celestial objects, including 105 stars, the bright and dark bands of Jupiter, the rings of Saturn, etc. Stars to the 6.7 magnitude were measured, and the whole research constitutes the first really successful measurement of stellar radiation by means of instruments of this type. The data obtained have already found useful application and it is hoped that further work may be continued. With this end in view, the above mentioned investigation of the efficiency of galvanometer coils was made; further work is in progress on increasing the sensitivity of the galvanometer and the thermocouples. Recently two papers have been published by astronomers who used the above-mentioned radiometric measurements in discussing the probable temperature of stars.

5. CHEMISTRY.

Standard Analyzed Samples.

The demand for the standard samples that are under the control of the chemistry division has shown a good increase of almost 200 over the previous year. A part of this increase arises from the

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abnormal demands of the last four months on the part of certain industries, growing out of the European war.

The worth of the Bureau's series of analyzed standard samples, and the need of standards of analysis of the highest purity to those engaged in industrial pursuits, as well as to those engaged in teaching and studying, is so well established that the maintenance and increase of this series of (at present) 38 samples should be assured by a moderate fund continued from year to year. This fund should be available for salaries and travel, as well as for the purchase and preparation of materials, apparatus, and appliances. It is believed that an annual appropriation of $4,000 or $5,000 will cover expenses of every kind in connection with these standard samples.

No new samples have been added to the existing series, but the Alabama iron, referred to in the last report as iron E, has been subjected to analysis and will be issued to the public as soon as certain discrepancies are reconciled. An interesting development of the analysis of this iron is the discovery that it has an unusually high vanadium content of about 0.08 per cent. The inquiry at once suggested itself: Is this normal or accidental? If normal, it would mean that the Alabama ore, coke, or flux used in making this particular iron were, one or more, appreciably vanadiferous. Tests instituted by the chief chemist of the Tennessee Coal & Iron Co., at the suggestion of the Bureau, show as far as they go that the Alabama ores and coke, but not the limestone flux, do carry vanadium, but in amounts less than is shown by the pig iron E. The matter has undoubtedly some commercial significance and should be investigated further by those interested.

It has not been possible as yet to devise a method by which a cast brass can be produced of composition so uniform throughout the ingot as to obviate the need of mixing after the mass has been reduced to chips. The method of "atomizing" a pot of molten metal by means of superheated steam seems well adapted for relatively low melting alloys, like type metal and babbitts, but has not been successfully applied yet to brasses. Even with the white alloys, the yield of grains of suitable size is rather low (30 to 40 per cent), so that an inconveniently large mass must be melted in one lot in order to provide the needed few hundred pounds of finished product. In cooperation with the Bureau, experiments will be continued by representatives of the National Lead Co. and the New Jersey Zinc Co. in the hope that the process can be improved and made applicable to the higher melting alloys.

Chemical Tests of an Umpire Nature.

The Bureau is frequently requested to determine for commercial firms, or to help them to determine, the composition of a material which they wish to employ as an analytical standard in their own work or concerning the composition of which there is seemingly irreconcilable dispute. Such requests usually involve more or less research and are refused unless it is shown that their own or commercial analysts are unable to afford the information sought. If shown, however, it is held to be eminently proper to give all the aid possible.

Some recent tests of this nature have been on the manganese content of a certain steel standard; the silicon content of certain steels;

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the sulphur content of certain irons; the lead content of a western standard lead ore; and the correct determination of cadmium in spelter.

Usually the work done at the Bureau has been accepted as conclusive by those interested, either as to the true composition or as to the method used. The reputation of the Bureau as a court of resort in many lines of chemical analysis is high, and it should be maintained by increasing the number of men assignable to analytical research of a high order and adequately recognizing the ability of those who prove themselves most worthy.

Investigation of the Methods Relating to the Analysis of Irons and Steels.

The large amount of iron and steel testing called for and the large number of new methods of analysis, or modifications of old methods that are put forth, make it imperative to devote perhaps more time to trying out certain of these methods than is the case in any other branch of the Bureau's analytical work. Such work may lead to modifications of the methods employed by the Bureau, but as a rule the knowledge acquired from it, while of value, is not of a kind to justify publication. Examples of this kind that have been handled are, precipitation of tungsten as the pentoxide by stannous chloride; the influence of vanadium on the titration of iron by potassium dichromate; the titration of titanium solutions by ferric chloride; the titration of ferric chloride by sodium thiosulphate; the reduction of compounds of chromium, vanadium, molybdenum, and tungsten in the zinc reductor, and, the titration of iron by stannous chloride. A new method of determining vanadium and chromium in the presence of each other is now being studied.

Preparation of Iron Carbon Alloys.

The preparation of pure electrolytic iron and of alloys of iron and carbon begun in the previous year has been actively continued in cooperation with the Division of Metallurgy. A paper embodying the results of this research is nearly ready. The technique necessary for such investigations, involving the selection of suitable furnaces, crucibles, electrolytic baths, and related questions, has been worked out for this and similar future investigations. A series of alloys with not to exceed 0.02 per cent of total impurities has been made for use in exploring the thermal equilibrium diagram for the iron-carbon system. Preparation of large ingots by similar methods for investigating other physical properties is under way.

High-Temperature Carbon Combustions.

The experimental work on high-temperature carbon combustions, referred to in the last report, has been completed and the results are being prepared for publication. Suitable high-temperature apparatus has been devised for making combustions at a temperature above the melting point of iron oxide, so that carbon retained by the oxide may be liberated. The method has been applied to a wide range of the Bureau's standard irons and steel samples, with the result that the certificate values are in most cases confirmed, the maximum deviation by the new method being 0.02 per cent carbon (higher) in one or two instances.

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Test of Surface Combustion Furnace.

Much work has been done on a furnace for high combustion and a paper on the subject is about ready for publication. The work shows that temperatures in excess of 1700° C. can be obtained readily with gas of not over 620 B. t. u. heating power; that the best ratio of air to gas is in the neighborhood of 5.5 to 1, and that small deviations from this ratio exert marked effects on the maximum temperature attained. Further work with refractories that will permit of attaining higher temperatures is contemplated.

Ladle Test Ingot Investigation.

The first stage of the ladle test ingot investigation is completed and has been reported upon to the American Society for Testing Materials. The conclusion reached is that no geometrical shape of test piece can be chosen to give a sound ingot unless the steel has had previous suitable metallurgical treatment to eliminate the harmful effect of occluded or dissolved gases, oxides, and slags. The next stage of the work will be an endeavor to find a simple and proper treatment to insure sound ingots.

Standard Methods for the Analysis of Pig Iron and Iron Castings for Export.

The chief chemist of the Bureau, as the American representative on a subcommittee of the International Society for Testing Materials, has prepared, with the assistance of other experts, proposed methods for the analysis of pig iron and iron castings for export, which will appear in this year's Year Book of the American Society for Testing Materials as tentative methods for use in this country, subject to final action by the society a year hence.

Standard Methods for the Analysis of Steels.

In cooperation with the American Society for Testing Materials, the Bureau has taken a leading part in compiling methods for the analysis of plain and alloy steels. The first of these specifications has received the approval of the society and the second is before the society for further action.

Tests on Steel for Other Divisions of the Bureau.

Many analytical tests of a more or less extended nature have been made in cooperation with other divisions of the Bureau, among which may be specially mentioned those on rail failures.

Sampling and Analysis of Coal.

In cooperation with the committee on coal analysis of the American Chemical Society, acting in conjunction with a similar committee of the American Society for Testing Materials, the Bureau has helped in the revision of methods for the sampling and analysis of coal. These methods are now before the latter society for a year's consideration before the final vote is taken.

Chemical Work in Connection with Paper.

The first of the work on paper pulp is nearing completion. The chemical constants of the more important pulps have been deter-

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mined, and the resistance of the pulps to hydrolizing and oxidizing agents has been ascertained. The effect of esterification has been studied. The observations made will assist in a later study of the effect of filling and sizing agents upon the life of paper.

The study of changes occurring in ground wood pulp under the influence of active oxygen, sunlight, and heat has been completed. This is of importance in determining the effect of residues of lignin in paper pulps.

Some information has been gained on the determination of sizing agents.

Textiles.

The chemical division has made numerous determinations of moisture in fabrics for the textile section of the Bureau in an effort to substitute a bone-dry basis for the air conditioning of textiles. A large amount of routine examination of fabrics has also been conducted for the textile section.

Distinguishing Sisal and Manila.

An attempt has been made to find some means by the use of stains of distinguishing manila from sisal in cordages, but with only partial success, since such distinctions as have been noted are not applicable to both coarse and fine varieties. The situation has been put before manufacturers of cordage in the hope that some of them may be able to follow up the clues indicated by the Bureau.

Lubricating and Transformer Oils.

Considerable time has been spent in endeavoring to improve the "carbonization" test and to connect the carbonization factor with the behavior of oils under other conditions. The results of this investigation are now being prepared for publication. The test, similar to that of Kissling, seems to give satisfaction with gas-engine oils. A leading oil refinery used part of one of the Bureau's reports as an advertisement and quite recently the Bureau was informed that the oil purchased on its recommendation by the Post Office Department is entirely satisfactory.

Data on the carbonization of other classes of oils are being accumulated.

Gum Arabic.

A research begun in the early days of the Bureau's chemical activities on methods for detecting and determining gum arabic has been renewed. A new method was devised, but has been withheld until more information can be gathered as to one or two points. This work was taken up in connection with Government purchases.

Articles Involving Danger to Life or Property.

Many reports and opinions covering the chemical composition of a wide range of substances supposed to involve fire or life risk have been prepared for the Steamboat-Inspection Service to serve as a basis for its decisions regarding the acceptance of the articles in question as freight by passenger-carrying vessels. In most cases no laboratory work was necessary; in others, simple tests sufficed, while

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the still pending question of ferrosilicon may eventually lead to an experimental research.

Some of the more important subjects upon which the Bureau has been requested to report with reference to safety are ferrosilicon, porosity of fillers used in acetylene cylinders, thermit, polishing cloth, and slickers.

Chemical Analysis of Rubber.

Considerable progress has been made in studying methods of chemical analysis for rubber goods. A paper on the determination of total sulphur in rubber is in print and another on the determination of barium sulphate and carbonate is nearly completed. Since many specifications permit the use of barium sulphate as a mineral filler without having the sulphur which it contains considered as part of the total sulphur, it is necessary to be able to determine this constituent in the presence of any possible disturbing factor.

Cooperative work on rubber has been continued with two organizations, namely, the American Chemical Society and the Joint Rubber Insulation Committee. In cooperation with the latter body, the Bureau has devoted much effort to the development of a more satisfactory method for the determination of fillers in rubber.

The rubber experimental mill at the Bureau has been in successful operation and has proved of much assistance in connection with the above investigation. Its use has revealed the fact that the Bureau's method for determining the amount of oil substitutes present in rubber compounds yields low results.

A tubing machine and a steam vulcanizer have been added to the existing equipment and with these the subject of rubber laboratory tubing will be investigated. The Bureau has taken up this subject of tubing with several manufacturers and as a result three new compounds are now being tried out in actual service. It is hoped that these compounds will be more satisfactory than those that have been obtainable from the schedule of the General Supply Committee.

A third edition of Circular No. 38, on the Testing of Rubber Goods, has been issued, very much enlarged by the addition of new matter, including the chemical methods in use at the Bureau.

Printing Ink.

Circular No. 53, on The Composition, Properties, and Testing of Printing Inks, has been issued and is in frequent demand. Additional information is being gathered for the purpose of extending the scope of this circular. Very little has been published heretofore on the subject.

Determination of Oil and Resin in Varnish.

The Bureau has been studying the question of the determination of oil and resin in varnish and the results obtained show a decided advance in this difficult subject. A paper dealing with this investigation is now in course of preparation.

Soap.

Practically all branches of the Government service have been invited to cooperate with the chemistry division of the Bureau in pre-

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paring specifications for soap materials, with the view of reducing the number of varieties now bought and of making it easier for manufacturers to bid in connection with the annual contracts. There has been prepared the first draft of a circular of information on soap, which is now in the hands of representatives of the various branches of the Government service and numerous manufacturers for criticism.

Paint Investigation.

The question of specifications for materials used in paints and varnishes has always occupied a considerable share of the attention of the chemical division. The preparation of specifications for paint materials is an important field of work and much thought has been devoted to this subject in cooperation with the American Society for Testing Materials. Other subjects handled during the past year in cooperation with the same society have been the revision of specifications for purity of raw linseed oil from North American seed, new specifications for the purity of boiled linseed oil from North American seed, the purity of raw Chinese wood oil, turpentine, and the definition of terms used in paint specifications. It is believed that this work will be of material assistance to the paint and varnish industries, as well as to the users of these materials. The Bureau has also cooperated in preparing methods for the analysis of white pigments, which are now being considered for adoption by the American Society for Testing Materials. These methods of analysis were developed almost entirely in this Bureau and a large amount of work incident to the preparation of the specifications and definitions was done by the chemistry division.

Considerable work has been done during the past year in connection with an exposure test of certain commercial white paints on wood. This investigation is still in progress.

Gas Analysis.

In furtherance of the Bureau's efforts to improve and standardize methods of gas testing, a comprehensive investigation of the lead-acetate test for hydrogen sulphide in gas was carried out and the results have been published as Technologic Paper No. 41. The numerous factors which affect the delicacy and reproducibility of this test, which is of importance in testing the purity of satisfactory gas supplies, have been investigated and a standard procedure and apparatus for carrying out the test have been recommended. It is of interest to note that the American Gas Institute has adopted practically the recommendation of the technologic paper for the gas analyst's handbook, which is in preparation.

An exhaustive study of methods and apparatus for exact and commercial gas analysis has been begun. Several new forms of apparatus for gas analysis and for use in closely related problems have been devised and are now under construction, including notably a weight burette with very accurate compensator for temperature changes and a balance for determining the specific gravity of small amounts of gas. A very complete bibliography of the literature on gas analysis has been prepared. This bibliography, which contains more than 2,000 references, is arranged in duplicate by subject and by author and includes many abstracts of the articles.

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Preparation and Testing of Gases of High Purity.

The Bureau has been engaged for some time in the preparation of apparatus and the devising of means for making in a high state of purity the various gases which are the constituents of commercial gas supplies. The preparation of these gases and the determination of their physical and chemical properties will form an important part of the laboratory investigation for a considerable time to come, being preliminary to the determination of the properties of their mixtures with each other as they occur in fuel and illuminating gases.

Hydrogen has been prepared by electrolysis and by the action of sulphuric acid on zinc and of hydrone on water. A generator working on the Kipp principle, but possessing a number of novel features, has been designed and constructed for use in generating hydrogen from zinc and acid. This generator can be evacuated completely before filling with acid and air-free acid can be introduced without danger of contamination. The space above the liquid in the reservoir is at all times filled with hydrogen of the highest purity, thus preventing the contamination by air of the hydrogen generated. A very satisfactory electrolytic generator and gas-purifying train has been constructed. Several samples of the hydrogen from the different sources mentioned have been tested by chemical analysis, by determining the density of the gas by weighing, and by intercomparison in the gas interferometer. The application of the interferometer in gas analysis problems is being studied, particularly as offering a valuable means for the accurate testing of the pure gases that are to be prepared.

Te determination of the heat of combustion of hydrogen has been undertaken by the chemical division in cooperation with the division on heat and thermometry. Satisfactory progress has been made on the preliminary series with this gas and it is planned to continue the work, both with the hydrogen and with the other pure gases as they are prepared. The methods developed on the pure gases can then be applied on synthetic mixtures of known composition. The calculation of the heating value of gas mixtures from results of analysis is very desirable, but until much progress shall have been made in the study of gas analysis, as well as in the study of calorimetric constants, there is little hope of making application of this method of computation for accurate work.

A number of pieces of apparatus worthy of mention have been designed for use in the laboratory work in connection with gas investigations. There has been designed, and constructed in the instrument shop of the Bureau, a gas holder of 14 liters capacity which is well adapted to storing gases of high purity without contamination, since the gas is retained in contact only with glass, steel, and mercury. Other pieces of apparatus that have been devised are an apparatus for the determination of sulphur in gas, possessing a marked advantage over that previously used; several new forms of gas-washing apparatus, which have been found very convenient in gas analytical work; and a new form of pipette for gas analysis work, intended to give rapid and complete absorption. A thermostat has also been built which will be used first in connection with the determination of gas density and later for general work in the laboratory. This apparatus operates very satisfactorily, the stirring and

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regulating devices being so efficient that the temperature is maintained constant within 0.005° C.

Control of Purity of the Bureau's Oxygen Supply.

The oxygen supply of the Bureau has been examined for possible impurities a number of times and tests have been made on it to determine the amount of combustible impurities which would vitiate the results obtained in exact calorimetry in which this oxygen has been used.

Colorimetric Determination of Acetylene.

Considerable attention has been given during the past year to an investigation of the colorimetric method for the determination of acetylene, suggested by work done in the previous year. An account of the earliest work on this general problem was published in December, 1914, in the Journal of the American Chemical Society as "A quantitative test for water by the use of the acetylene-cuprous chloride reaction." The quantitative application of the method for the determination of acetylene proved to be very satisfactory, as results indicate a possible accuracy of about 0.02 mg. C_2H_2, but the effort which was made to apply the method to the quantitative determination of very small amounts of water brought to light two difficulties which seemed insurmountable, namely, (1) the difficulty of removal of acetylene from the calcium carbide which was used, and (2) the incompleteness of the evolution of acetylene from the water in the samples taken. A paper embodying the results of this research is nearly ready for publication.

Determination of Phosphorus and Sulphur in Calcium Carbide.

A new method for the determination of phosphorus and sulphur in calcium carbide has been developed, but the results of the investigation have not yet been prepared for publication.

Distillation of Liquid Air in a Magnetic Field.

A brief article was prepared and published in the Journal of the American Chemical Society on experiments made two years ago on the distillation of liquid air in a magnetic field. The object of the research was to ascertain if distillation in the magnetic field would have a favorable effect on the separation of the constituents of the air; apparently some advantage does accrue, but not a great one.

Preparation of Naphthalene.

A new lot of naphthalene was prepared by the chemistry division for use as a standard material for the calibration of calorimeters. Fifty pounds of crude material was purified by crystallization with subsequent sublimation in vacuo.

Bituminous Materials.

A careful study has been made of the equipment and methods for testing bituminous materials in the laboratories of manufacturers, consumers, public institutions, and others, and as a result the equipment of the laboratory of the Bureau dealing with these materials has been brought more up to date and important modifications have

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been made in the methods in use for routine testing. In connection with bituminous paints, it has been found that the asphalt used is fluxed not only with the common fluxes, asphaltum or paraffin oils, but also with rosin, pine oil, stearine pitch, fats, and fatty acids.

Phosphate Rock Analysis.

Very little, if any, progress has been made on the problems relating to the analysis of phosphate rock. It is very desirable that this work be carried to completion in order to render available the large amount of data that has already been obtained on this subject.

The Chemistry of Electrotyping.

The study begun over a year ago to give electrotypers much needed information for the control of their solutions has been prosecuted actively, mainly by analyzing a large number of samples received from commercial electrotyping plants. The primary object of these analyses was to gain a knowledge of the conditions now prevailing in the industry and of the problems in need of study.

In addition an effort has been made to get into closer touch with electrotypers' organizations, both of employers and employees, by means of informal interviews, wherein the nature and advantages of scientific work in this field are pointed out. In general these bodies have shown a marked interest in such work. A brief circular (Circular No. 52), giving simple methods of analysis of copper electrotyping solutions, has been issued. A revision of this circular is now in preparation which will contain a summary of the information that is available in this field and an explanation of the simple electrical and chemical terms.

In cooperation with representatives of the electrotyping industry and with certain other divisions of the Bureau, the chemistry division has undertaken the following researches in connection with this subject: The determination of the density of copper sulphate-sulphuric acid solutions; the determination of the conductivity of copper sulphate-sulphuric acid solutions; a study of the effect of the conditions of deposition upon the hardness, tensile strength, and structure of electrolytically deposited copper; and the possibility of the application of cobalt deposition to electrotyping.

Other problems in urgent need of study for the benefit of the electrotyper's industry are the composition and physical properties of ozocerite and other materials used in molding wax, the composition and physical properties of graphites suitable for electrotyping, and the operation of nickel electrotyping baths. The latter might well be included in a study of nickel-plating baths in general.

Investigations Relating to Electroplating.

The advance thus far made toward the study of electroplating has been of interest primarily to electrotypers. The American Electroplaters' Society recently requested the Bureau to cooperate with them in a study of plating operations. Such a study would involve problems in electrochemistry, analytical chemistry, and metallography. It is impossible, however, for the present limited force to make rapid progress in the electrotyping field, let alone that of

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electroplating. It is recommended, therefore, that a special fund be secured, if possible, to be devoted to the study of electrotyping and electroplating problems.

Standard Cells.

Progress on the investigations having to do with standards of electromotive force has not been on the whole as satisfactory as could be desired, because of frequent interruptions made necessary by other work. A few cells have been set up with mercurous sulphate made by the alternating current, which gives very constant and reproducible results. Twenty kilograms of cadmium sulphate have been purified and this material will be used in setting up the large series of cells necessary to test the alternating current product. Some 20 additional samples of mercurous sulphate have been made under conditions where each of the factors have been varied for the purpose of determining the best conditions of preparation, although it is already fairly well known just what constitutes satisfactory conditions. This preparative work, which can be almost indefinitely extended, has been temporarily abandoned and the setting up of cells with material made under conditions that are satisfactory will give results in the immediate future. Unsaturated cells have been set up for the first time for the use of the Bureau's laboratories, and they show excellent behavior.

Chemical Work in Connection with Refrigeration Constants.

Progress in work on the constants of materials used in refrigeration has been satisfactory. The purification of materials is well in hand and has been keeping pace with the requirements of those interests using them for physical measurements.

The subject of ammonia has been occupying a considerable share of the attention of the chemistry division. An apparatus with many new features has been devised for the fractional distillation and, possibly, the sublimation of substances at low temperatures. In cooperation with the optical division, the use of the characteristic absorption bands of pyridine in the ultra-violet has been tested, using aqua-ammonia. The indications are that this test is sensitive to 3 parts in 1,000,000. Further work is necessary and, if possible, a similar method will be applied for the detection of acetonitrile in ammonia. Carbon compounds as such are being tested for by combustion of the gaseous ammonia in oxygen and estimation of the carbon dioxide formed.

While it has been possible to pick out the best commercial ammonia as a starting point for preparative work, and perhaps for general chemical work where gaseous ammonia may be used, it will be necessary to do some additional work before rational specifications for the material can be developed. Results obtained from the investigation being conducted on gas formation will have a considerable bearing on these specifications.

The cause of formation of noncondensing gases has been attacked from all the various points that have suggested themselves, which makes the work rather extensive in scope. Work on the following more or less independent phases of the problem is under way and

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some progress has been made on each: The solubility of gases in liquid ammonia; decomposition of ammonia under working conditions of both the absorption and compression plants, which are to be simulated in an apparatus for that purpose; gas formation under working conditions in the plant of the Bureau with special reference to the locality of formation and behavior of the gas in the system; and a study of the quantity of the gas formed and the amount of ammonia lost in purging in the commercial plants of Washington and Baltimore.

Sodium chloride has been purified for use in making brines for the density and specific heat determinations. Calcium and magnesium chlorides that are to be used for similar purposes have been analyzed.

Conductivity of Electrolytic Standards.

Some progress has been made on the investigation of the absolute measurement of electrolytic resistance. It is desirable that more attention be given to this important problem, since the need for research on this subject is becoming more and more evident.

Platinum Investigation.

It is not necessary to renew in its entirety the suggestion of last year for the transfer of the Mint's platinum to the Bureau of Standards, since the Director of the Mint has undertaken, as soon as arrangements can be made, to provide Government laboratories with platinum utensils derived from the platinum which accumulates during refining operations in the Mint. There will be needed, however, an advanced analyst to make a specialty of the analytical chemistry of the platinum metals, for upon such work will depend in large measure the value of the advice this Bureau can give to the Mint in reference to the proper specifications for different forms of finished ware. The services of a very competent chemist will be needed for some years, working in cooperation with certain other divisions of the Bureau, on the determination of the constants of the metals of the platinum group and of their alloys.

Research of the Methods and Standards Employed in Volumetric Analysis.

A study of the methods and standards employed in volumetric analysis is of fundamental importance for exact work in almost all lines of chemical analysis. The need for this research is even more pressing than a year ago, and work should be undertaken on this important problem as soon as possible. The services of a chemist qualified in physical and analytical chemistry will first be needed and with the advancement of the work additional help will become necessary.

Chemical Testing.

The routine testing in the chemical division during the past year has increased very largely in consequence of taking over the work of the contracts laboratory of the Bureau of Chemistry. However, the increase is not altogether due to this cause, since there has also been a noticeable increase due to improved methods in the purchasing of Government supplies.

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More than 12,500 tests of materials were made by the chemical division during the year. They involved the following materials: Ferrous metals (irons and steels), 981; coated metals, 641; nonferrous metals and alloys, 1,106; material from electrotyping baths, 398; cement materials, 1,296; coal tars and asphalts, 533; saturated felts, 258; burlap and building paper, 211; linseed oil and turpentine, 541; driers, 313; varnish and shellac, 610; red lead, 184; white lead, 284; putty, 186; graphite paint, 249; miscellaneous paint colors, 472; greases, 51; soaps, nondrying oils, and metal polishes, 498; oils (lubricating), 373; inks (printing), 28; ink materials other than for printing, 474; flax packing, 24; asbestos, 39; paper, 2,267; rubber, 256; rope, 5; wax (sealing), 30; wools, 39; textile materials, 49; miscellaneous materials, 410.

The Bureau's chemical tests were made for about 70 Government bureaus and establishments, including practically every executive department, as follows: Agriculture, 24; Commerce, 906; Interior, 93; Labor, 44; Navy, 302; Post Office, 564; State, 1; Treasury, 495; War, 403; United States committees and commissions, 45; General Supply Committee, 610; Isthmian Canal Commission, 3,144; Government Printing Office, 1,685; other independent Government establishments, 5,491; State, municipal and other institutions and committees, 318; and private parties, 419.

During the past year there were distributed 1,633 iron and steel samples, 48 brass samples, 155 ore samples, and 90 sodium oxalate samples, as against 1,300 iron and steel samples, 57 brass samples, 183 ore samples, and 89 sodium oxalate samples distributed during the previous year. No samples for colorimetric and polarimetric standardization are included in these statistics. Since the chemistry division has now taken over the responsibility for the prompt shipping of these latter samples and is also mainly responsible for their preparation, it is intended to include them in subsequent reports from this division.

Miscellaneous Chemical Tests.

In addition to the routine testing mentioned above, certain miscellaneous tests were made for the Government and others, which were sufficiently thorough in character to make them partake of the nature of investigations. Among the subjects treated in this connection were metal polishes; the removal of stains from painted and varnished surfaces and marble; preparation of ink for marking metal time cards; preparation of specifications for imitation Damar varnish; methods of applying enamel to small articles, such as shoe buckles; kapok, its value in life preservers; rendering the paper of drawings and prints sufficiently transparent to enable blue prints to be made directly; a substitute for galvanizing; prevention of the rusting of iron; and the action of boiler compounds.

Publications.

The following papers and circulars have been published during the year or are nearly ready for publication, namely, "Hewettite, Metahewettite, and Pascoite, Hydrous Calcium Vanadates" (in cooperation with the geophysical laboratory of the Carnegie Institu-

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tion of Washington, and published in the Proceedings of the American Philosophical Society); Scientific Paper No. 232, "Equilibrium in the System Lead Acetate" (in cooperation with the optical division); Technologic Paper No. 41, "Lead Acetate Test for Hydrogen Sulphide in Gas"; Circular No. 48, "Standard Methods of Gas Testing"; Distillation of Liquid Air in a Magnetic Field" (published in the Journal of the American Chemical Society, vol. 37, p. 1715); third revised edition of Circular No. 32, "State and Municipal Regulations for the Quality, Distribution, and Testing of Illuminating Gas"; "Technical Work of the Bureau of Standards in the Gas Field" (published in the Gas Record, vol. 1, p. 291); Circular No. 53, "The Composition, Properties, and Testing of Printing Inks"; Technologic Paper No. 45, "A Study of Some Recent Methods for the Determination of Total Sulphur in Rubber"; third edition, enlarged, of Circular No. 38, "The Testing of Mechanical Rubber Goods"; "The Determination of Oil and Rosin in Varnish" (nearly ready for publication); Circular No. 52, "Regulation of Electrotyping Solutions"; "Gas-Washing Apparatus with Enclosed Filter" (published in the Journal of Industrial and Engineering Chemistry, vol. 7, p. 534); "Apparatus for the Determination of Sulphur in Gas" (published in the Journal of Industrial and Engineering Chemistry, vol. 7, p. 620); "A Qualitative Test for Water by the Use of Acetylene-Cuprous Chloride Reaction" (Journal of the American Chemical Society, vol. 36, p. 2462); "The Colorimetric Determination of Acetylene" (nearly ready for publication); "A simple Stone-Frame Chemical Hood" (published in the Journal of Industrial and Engineering Chemistry, vol. 7, p. 1726); "The Preparation of Pure Iron and Iron-Carbon Alloys" (nearly ready for publication); "A Test of a Surface Combustion Furnace" (nearly ready for publication); "Determination of Carbon in Steels and Irons by Direct Combustion in Oxygen at High Temperatures" (published in the Journal of the Washington Academy of Science, vol. 4, pp. 393, 1914).

Transfer of the Work of the Contracts Laboratory of the Bureau of Chemistry to the Bureau of Standards.

On July 1, 1914, in accordance with congressional provision, the work of the contracts laboratory of the Bureau of Chemistry was assumed by the chemical division of this Bureau. Owing to the similarity of this work with that of the existing structural materials laboratory, it was deemed advisable to operate the two forces as a single unit until a plan for reorganization could be effected. This reorganization has been accomplished and the work is now proceeding in a satisfactory manner.

The New Chemistry Building.

Throughout the year a building committee consisting of members of the chemical staff of the Bureau, with the aid of the superintendent of the Bureau buildings and grounds, the architects, and the ventilating engineer, have been engaged in preparing plans for the new chemistry building authorized by Congress. The plans for the building have been completed and the specifications printed. It is

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expected that the construction of the laboratory will begin by September 1.

6. ENGINEERING RESEARCH AND TESTING.

Physical Equations.

During the past year the following papers along the lines of technical thermodynamics and engineering physics have been published:

"Physically Similar Systems. Illustrations of the Use of Dimensional Equations," published in October, 1914, in which is considered an important theorem regarding the forms of complete physical equations, which is the most convenient statement, for practical use, of the principle dimensional homogeneity.

"Formulæ for the Windage of Flywheels," published on January 15, 1915.

"Model Experiments and the Forms of Empirical Equations," presented to the June meeting of the American Society of Mechanical Engineers.

These papers will all form parts of a more comprehensive paper to be published by the Bureau later.

A short paper has also been prepared on the dimensional theory of wind-tunnel experiments to accompany a series of experimental papers published by the Smithsonian Institution.

Aerodynamics.

Numerous requests for information or for experimental work on aerodynamics have been received; for example, on subway ventilation, testing of roof ventilators, the design of windmills and aero propellers, and the characteristics of aeroplane speedometers. Information has been supplied on some of these points and experimental tests have been made on air meters, anemometers, and electric fans. The most important of such requests and inquiries have come from the National Advisory Committee for Aeronautics. A report on existing types of aeroplane speedometers has been furnished to them and will be published later by the Bureau, and work is now in progress on the design of a new speedometer for use by the Army and Navy.

In the further development of aeronautics and aviation, many physical investigations must be carried on in cooperation with constructors and operators and in response to requests for physical information and numerical data suggested by their practical experience. It is important that the Government be able to have this purely scientific work done in its own physical laboratory, the Bureau of Standards.

While some of this work can be taken care of under the present conditions at the Bureau, to respond satisfactorily to the demands which are being made the Bureau must have an adequate equipment for experimental research in aerodynamics, and such an addition to its staff as will permit of important new investigations being undertaken as requested and without unreasonable delay. It is therefore proposed to establish a section of aerodynamics to take charge of this work.

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Vacuum Cleaners.

Portable vacuum cleaners for use in public buildings are purchased by the Treasury Department under specifications which are based upon the results of an investigation recently conducted at this Bureau. As a result of the Bureau's work in this field manufacturers have introduced certain changes in the design of their machines which increase both their efficiency and capacity as shown by tests under operating conditions.

Radiator Traps Used in Connection with Vacuum Systems of Heating.

Information of decided practical value has been obtained in the investigation of radiator traps used in vacuum systems of heating. This work was undertaken at the request of the Supervising Architect of the Treasury. The special apparatus that was installed for conducting this investigation has given excellent results, and the study of the performance under operating conditions of 26 different makes of traps is nearing completion. The data obtained will be used in the preparation of specifications for radiator traps to be used in connection with the heating systems of Government buildings.

Anemometers as Speed Indicators for Aeroplanes.

At the request of the Langley Aerodynamical Laboratory, a report has been prepared on anemometers for use as speed indicators for aeroplanes. This report, which is based upon an exhaustive study of the various types of anemometers, including pitot tubes, will appear as a Bureau publication in the near future.

Water Current Meter Rating Station.

The testing of current meters, which was formerly conducted at Chevy Chase Lake, is now carried out in a reinforced concrete tank recently completed at the Bureau. This testing tank, which is 400 feet long, 6 feet wide, and 6 feet deep, offers excellent facilities for rating meters, particularly meters of special and delicate design such as are used by the Government bureaus to measure the velocity of ocean currents. The autographic recording mechanism designed at the Bureau and constructed in its instrument shops, and the electrically driven carriage with hydraulic gear for accurate speed control, constitute the most complete equipment for meter rating in this country. Although the new testing station has been in operation only a few months, meters for test have already been received from various parts of the United States and from Canada. The greater part of the Bureau's work in this field at present is for the Geological Survey and the Reclamation Service, but it is certain that the exceptional facilities offered by the new station will greatly increase the number of meters sent in by State governments and engineers.

Gasoline Engines.

The Bureau's laboratory for testing the power and fuel consumption of gasoline engines such as are used in automobiles, motor boats, and aeroplanes has been in operation for about two years. The electric absorption dynamometer used for this work was installed by

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the Signal Corps of the War Department, and has been operated under the Bureau's direction. A number of gasoline engines have been tested, but the large demands made upon the limited engineering force have rendered it impossible to undertake any experimental work in this field.

Tests of Miscellaneous Instruments and Devices.

The greater part of the Bureau's work in this field consists in the rating of current meters, of which 285 were tested during the past year. In addition, 131 tests of miscellaneous devices were made, including steam, vacuum, and hydraulic gauges, fire extinguishers, vacuum cleaners, anemometers, tachometers, water meters, valves, and life preservers.

7. METALLURGY.

Fusible Tin Boiler Plugs.

An investigation has been completed and prepared for publication on the failure and deterioration of fusible tin boiler plugs. This safety device for preventing boiler explosions is widely used in stationary and locomotive boilers and is required on the marine boilers on all steamboats coming under the jurisdiction of the Steamboat-Inspection Service, which Service brought the matter to the Bureau's attention through the failure of a plug to operate on the steamer *Jefferson*, causing loss of life. Some 1,200 plugs, both used and new, were examined, and this investigation has shown that, although pure tin is called for in the specifications, it often is not furnished by the manufacturer. It appears that only 0.3 per cent zinc as impurity is sufficient to eventually cause the complete oxidation of the tin filling, thus rendering the plug dangerous, whereas strictly pure tin plugs will remain sound. Several of the specifications now in force are shown to be inadequate. It would probably we well to license a limited number of manufacturers of fusible boiler plugs whose product could be controlled by Federal inspection, and not permit promiscuous manufacture. At present the Steamboat-Inspection Service submits to this Bureau sample plugs from new manufacturers.

Properties and Standard Test Specimens of Bronzes.

The results of the investigation, undertaken at the suggestion of the American Institute of Metals, on the variations in foundry practice as influencing the properties of standard test specimens of the zinc bronze, known as Government bronze of composition 88 copper, 10 tin, 2 zinc, are embodied in a forthcoming technologic paper. The Bureau also has assisted in the preparation of the specifications for this bronze in cooperation with the American Society for Testing Materials. An extension of this work is outlined, consisting in the intercomparison of the properties of such specimens prepared from the same ingot metal, but by different foundries, according to a definite and uniform plan of procedure. This will afford information as to variations which may be expected in meeting specifications.

A metallographic examination has also been made, and the results are ready for publication, of the samples of zinc bronze (88 Cu, 10 Sn, 2 Zn) prepared at the Bureau by various methods. It would appear from this investigation that the presence and distribution

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of oxides in the casting is the predominating factor determining its quality.

This bronze has also been studied to determine its microstructural changes accompanying annealing. The results, which will be published shortly, show that the bronzes are very different in their behavior from steel and show no recrystallization or "grain refining" unless they have been previously cold worked, as by rolling or hammering.

Radiation from Metals and Oxides.

The radiation intensities characteristic of the several metals and oxides, or their monochromatic and total emissivities, are of considerable metallurgical and pyrometric importance. The work described in last year's report on "The Emissivity of Nickel Oxide" has since been issued as Scientific Paper No. 224.

The same methods have been applied to iron oxide and published in Scientific Paper No. 249. Iron oxide in the spectral region $\lambda=0.65\ \mu$ is almost "black," having an emissivity varying from 0.98 to 0.92 in the range 800° to 1,200° C. The total emissivity increases from 0.85 at 500° C. to 0.89 at 1,200° C. The corrections to be applied to optical and total radiation pyrometers when sighted on iron oxide are as follows:

	500 °C.	600 °C.	700 °C.	800 °C.	900 °C.	1,000 °C.	1,100 °C.	1,200 °C.
Optical pyrometer	0	0	0	+1	+2	+4	+6	+10
Radiation pyrometer	+30	+30	+35	+35	+40	+40	+45	.....

The micropyrometer (see Scientific Paper No. 198) has also been adapted to the measurement of the monochromatic radiation of metals and oxides, it being possible to take observations rapidly and over a large temperature range on a quantity as small as 0.01 mg. presenting a surface of 0.25 mm². The results of observations on 23 metals and 12 oxides have been published in Scientific Paper No. 242, showing that, in general, there is no temperature coefficient of emissivity and that for several metals, including platinum, there is a discontinuity in radiation at the melting point. This would render the Violle unit of light, based on platinum brightness at its melting point, a variable standard.

The Quality of Platinum Ware.

The thermoelectric method of classifying platinum ware, described in the last year's report, has been supplemented by measurements on the loss of weight of platinum on heating, with the object of determining the specifications and best composition for platinum ware, such as crucibles, which are subject to loss of weight on heating; a phenomenon which is very troublesome to the analytical chemist and which reduces the accuracy of his results. This investigation, which was undertaken at the suggestion of the American Chemical Society, afforded incidentally an opportunity, through the many samples examined, to form an estimate of the purity of high-

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grade platinum ware on the American market. Thus, of 164 samples examined, including a wide variety of objects, 43 pieces contained an equivalent iridium content of less than 0.5 per cent and 110 less than 2 per cent iridium. The loss of weight on heating for iron-free crucibles ranged from 0.71 mg. to 2.96 mg. per 100 cm^2 and per hour at 1,200°, the greater losses being for crucibles containing iridium and the lesser with those containing rhodium. From the thermoelectric measurements of purity, combined with a microscopic examination, the probable loss of weight for any platinum crucible can be predicted with sufficient accuracy for analytical purposes. It is suggested, for highest grade crucibles, that iron-free platinum containing 3 to 5 per cent rhodium be specified. This thermoelectric examination of platinum purity is now a regular Bureau test; also the Bureau's advice has been sought by several departments of the Government and other large users of platinum concerning purchases under this test.

Causes of Failures of Railway Materials.

In conjunction with the engineering and chemical divisions a comprehensive series of investigations of the causes of failure of railway materials has been undertaken, including some of the fundamental problems in the manufacture, design, and properties of rails, wheels, tires, and axles, as related to their failure in service.

During the past year considerable necessary equipment has been assembled and a start made on several problems, including sound-ingot research, rail-finishing temperatures, transverse fissures in rails, properties of cast iron, thermal analysis, and metallographic methods of examination.

A very important event in this connection was a meeting held at the Bureau May 22, 1915, attended by the technical representatives of 24 railway systems, at which the work of the Bureau on railway materials was discussed and a plan of cordial cooperation inaugurated, including the furnishing by the railways of statistics of failures and material for examination. It is believed that by thus working in cooperation with the railroads and gaining the benefits of their varied and extensive experience and technical advice, more rapid and efficient progress in the solution of the problems of the causes of failure of railway material will be made. The advantages of a centralized experimental laboratory which also has access to the material in service are manifest.

Causes of Failure in Car Wheels.

A study of car wheels is projected in view of the fact that they constitute one of the principal causes of railway accidents, and there are many matters of uncertainty as to best practice in manufacture and design. There are, for example, over 20,000,000 "chilled cast-iron" wheels in use in the United States and they are interchangeable from one railway to another, so that specifications should be rigid and uniform. Some of the items to be studied are statistics, foundry practice, mixtures used in manufacture, effect of sulphur on properties, braking and internal strains, strength of and best design, properties of hot cast iron, soaking pit practice, and relation of combined carbon to annealing. A beginning has been made on the last item.

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Transverse Fissures in Rails.

The problem which the railway conference of May 22, 1915, considered the most urgent is the determination of the causes of "transverse fissures," a hidden defect or split in the rail which often makes its occurrence evident only by the rupture of the rail by a train. A series of questions on this subject have been submitted to practically all the railroads in the United States, asking for their experience, data and samples, and for suggestions as to methods of attack. The replies which are being received will be a most valuable guide in orienting this investigation, which will involve work in the laboratory, mill, and service, including trials of artificial producton of such fissures by several methods, metallographic and chemical surveys of rails containing fissures compared with sound rails, examination of rails which have withstood long, severe service, and the effects of mill practice, including internal strains, gagging, and the completion of the chemical reactions across the rail section as influenced by manufacture. It is also hoped to have the cooperation of the optics division in the determination of the variation of expansion coefficient across the rail section.

Finishing Temperatures of Rails.

The survey of American practice regarding the finishing temperatures and properties of rails, mentioned in last year's report, was presented before the American Institute of Mining Engineers and has been published as Technologic Paper No. 38. The subject of finishing temperatures is one of the greatest importance in rail manufacture, and the discussion of the subject was participated in by several of the most prominent authorities in the country; and this discussion brought out a general confession of ignorance of many matters connected with the relation of methods of manufacture to the resulting properties of rails. It is hoped to be able to aid in the solution of some of these outstanding uncertainties. In Technologic Paper No. 38, the "shrinkage clause" in rail specifications such as those of the American Society for Testing Materials (defining the finishing temperatures by the shrinkage of the rail) was shown not to fulfill the intended requirements of its framers in limiting the temperature to slightly above the recalescence point. The rail committee of the American Society for Testing Materials presented a report concluding "there is lacking anything which points to such decided differences in the quality of rails rolled at varying temperatures as theoretical considerations have led some of us to expect." The society has instructed its rail committee to cooperate with the Bureau in a further investigation of this important matter.

It is also proposed to study several allied questions, including the relation of rail section to the temperature distribution on cooling, and the relation of the latter to the completeness of the chemical reactions, internal stresses, and metallographic transformation for different sections and compositions of rails.

Sound Ingot Research.

The use of only sound steel ingots for the manufacture of rails and other structures, on which the safety of the public depends, is a matter of the greatest importance. With the cooperation of several

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steel manufacturers, the Bureau has been enabled to compare the behavior and properties of several types of ingot, including the Hadfield form, consisting in (1) piping steel, (2) cast large end up, (3) suitable sink head with (4) air blast on charcoal and slag. This method produces an ingot, 90 per cent of which is physically and chemically sound. The results of this investigation, including also an examination of rails rolled from some of these ingots, were presented before the American Institute of Mining Engineers and also before the British Iron and Steel Institute. Opportunity has also been offered for a further study of this type of ingot by the Pennsylvania Railroad, which is to have rolled into rails 100 tons of Hadfield ingots, to be studied in detail by the Bureau.

Arrangements are also being made to study other processes of manufacture of sound ingots, such as the compression process of Mr. B. Talbot, of Middlesbrough, England, and the "hot-top" ingots of the Cambria Steel Co., together with an examination of the effects of such ingredients as vanadium and titanium.

It is believed that an impartial study by the Bureau of the methods of manufacture of steel ingots, blooms, rails, and similar products will be helpful in stimulating an improvement in manufacturing methods and should result in more rigid specifications being enforced for those products the use of which involves life hazard.

Test Ingot Investigation.

A matter of very great practical importance in the buying and selling of steel, involving acceptance or rejection of the material under specifications, is the determination of its analysis. The usual practice is to take for analysis a "test ingot" from the ladle before casting and assume this to be representative of the finished product. These test ingots vary greatly, however, in shape and size and quality, and it seemed desirable to endeavor to standardize this practice.

The study has been continued during the past year with the cooperation of the American Society for Testing Materials. Data have been collected regarding American practice in the matter of the shape and size of such ingots, methods of sampling, etc. Seventeen of the leading steel companies have cooperated in the work by furnishing sample ingots of various grades of metal. This first series examined represents ingots poured directly; that is, without the addition of aluminium, silicon, or other substances for rendering the metal compact and free from blowholes. Later the influence of such additions will be considered.

Fifty-five ingots have been examined up to date. This examination, so far, has been entirely metallographic, including the mapping out of the regions of segregation of sulphur (as an index of the segregation in general) and the determination of the presence of included "scale," oxides, etc., in the porous metal. Careful chemical surveys of selected types will supplement and confirm this work. Up to the present the investigation seems to warrant the conclusion that shape and size of the ladle ingots are minor factors and that the investigation of the subject of additions to the metal upon pouring to render the ingot sound and free from holes is the most satisfactory solution of the problem.

This work should be extended eventually by a comparison of "test ingot" analysis with that of the finished products. It would ap-

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pear that, at least for certain classes of materials, such as rails, the "test ingot" method of analysis should be rejected in favor of the analysis of the finished product.

Foreign Railway Specifications.

A technological paper has been prepared on foreign railway specifications for rails, wheels, axles, and tires. This material was collected with the aid of the Department of State from the Governments or railway administrations of Austria-Hungary, Belgium, France, Germany, Great Britain, Holland, Italy, Russia, and Sweden. The circular contains a comparison and discussion of these specifications, including a summary of accident statistics, as well as translations of the foreign text of the specifications for rails, wheels, axles, and tires. It is expected the circular will be of interest to those responsible for and interested in the specifications for such railway material in the United States. In general, it may be stated that the foreign railway material, such as rails, wheels, tires, and axles, appear to perform the duty imposed upon them in a more adequate manner than is the case in America.

Failure of Structural Brasses.

A comprehensive study of the causes of failure in service of structural brasses and bronzes has been undertaken by the Bureau. The costly experience of the New York Board of Water Supply on its Catskill Aqueduct project as well as the failures of bronze in the Minneapolis filter plant and elsewhere, the former of which has been widely advertised, raised the questions whether the bronzes used for such structural purposes were suitable for the purposes for which they were designed, whether the specifications were inadequate, or the methods of manufacture at fault. There appears to be a very serious lack of reliable data upon which to draw up specifications for this type of material and the ordinary tests do not usually give an indication of the true permanency of such bronzes which may easily be spoiled in manufacture.

The Bureau has had the cooperation of a number of brass and bronze manufacturers who have furnished material made, as suggested by the Bureau, in several ways; and the Bureau has been able to obtain failed material from several sources, including the New York water board, city of Minneapolis, and the Navy Department.

The relation of the presence of internal stresses to methods of manufacture and subsequent heat treatment have been carried out for numerous samples from various sources. It would appear that the presence of these internal stresses, sometimes associated with corrosion, is largely responsible for failure. It has also been shown these stresses can be removed by annealing, without serious detriment to the physical properties. The effects of corrosion on stressed brasses is also to be studied. There is in this problem of defining the just limitations of nonferrous alloys for structural and other purposes a wide field of research.

A preliminary account of the work already done is being prepared for publication.

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Preparation of Pure Iron and Iron Carbon Alloys.

It is shown that previous work on the iron-carbon diagram is unsatisfactory because of the great variation in the materials used. It was, therefore, thought necessary to produce a series of alloys of great purity to form the basis of a redetermination of the diagram at the Bureau of Standards. The general method consisted in melting electrolytic iron with sugar carbon in magnesia crucibles. The electrolytic iron was prepared from ingot iron anodes in a chloride bath with or without the use of porous cups. The operation of melting the iron with carbon gave great trouble at first because the ingots obtained were full of blowholes and contained considerable quantities of impurities. These difficulties were overcome by melting in a vacuum furnace and making crucibles of especially pure magnesia, made and calcined at the Bureau of Standards. A satisfactory procedure was finally worked out and a series of alloys prepared of the composition Fe+C=99.96 per cent.

The Iron-Carbon Equilibrium.

During the early part of 1914 work on the thermal analysis of pure iron was completed and the thermal study of the iron-carbon series was started. A large number of alloys ranging from 0.02 to 1.8 per cent carbon were made up and observations taken by the inverse rate and derived differential methods for some 250 heating and cooling curves. These observations have all been plotted and a study of the effect of rate on the location of the critical points has been started. Upon the completion of this work and a study of the effect of decarbonization, the results will be ready for publication. Work on this problem has been delayed or interrupted by the preparation and installation of exhibits for the San Francisco exposition and by testing.

Determination and Distribution of Carbon in Steels and Irons.

The improvement of analytical methods in metallurgical chemistry are of great economic significance as well as of scientific interest. Two methods for the rapid determination of carbon in steels have been devised, one by direct combustion in oxygen at high temperatures, a preliminary account of which has been published; the other by a conductivity titration method, which is in preparation.

The relation of the amount of graphite to the heat treatment of cast iron is of importance in the manufacture of chilled cast-iron wheels. Some preliminary work has been done in cooperation with one of the wheel manufacturers.

The Physical Properties of Pure Iron and Copper.

The pure iron made at the Bureau is being studied for several of its physical properties. Scientific Paper No. 236 has been published describing the experiments on the electrical resistance and temperature coefficient of pure iron between 0° and 950° C. These experiments, carried out with a precision of 1 in 300,000, demonstrate the nonexistence of transformations below 757° C., show the Ac_3 and Ar_3 transformations to begin at the same temperature 894° C. and extend over 25°, and accompanied by a decrease in resistance on heating and an increase on cooling through the A_3 transformation. The A_2 trans-

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formation, the interpretation of which is still in dispute, is evidenced by a very sharp cusp at 757° C. in the temperature coefficient curve, or by an inflexion in the resistance curve.

Exact measurements have been taken of the resistance of copper in the interval 0° to 100° C. with the object of detecting allotropic changes which have been reported by Prof. E. Cohen, of Utrecht.

Melting Points of Steels and Refractory Elements.

The determination of the melting points of a considerable number of steels of practical importance has been undertaken and is nearly complete. Also the melting points have been determined, by means of the micropyrometer, of practically all of the refractory chemical elements. It is hoped to be able to publish these results shortly.

A Test of a Surface Combustion Furnace.

In view of the fact that the surface combustion process appeared to offer many advantages for high-temperature laboratory furnaces, in which the Bureau is interested, it was decided to submit a crucible furnace of this type to a thorough test. For the purpose, the furnace was equipped with meters on the gas and air lines, and with a chimney to permit the collection of flue-gas samples. In several runs the mixture proportions were maintained constant while varying the rate of gas consumption. Temperatures were read by a Holburn-Kurlbaum optical pyrometer. The highest temperature reached was 1,675°, at which point the muffle failed. The test established that complete combustion could be attained without excess air, that the best air-gas ratio was 5·5, and that a 20 per cent excess of air caused a lowering of furnace temperature of 100°. An account of this test, which is the first of its kind, is in course of preparation.

Nomenclature of Nonferrous Alloys.

A paper which evoked considerable discussion was presented before the American Institute of Metals on the "Progress in the Nomenclature of Alloys." There is great need for systematizing the naming of complex alloys and of their constituents. The coining of new names and the use of proper names is being discouraged, and it is probable that from the several suggestions which have been made a rational system of nomenclature may be worked out which meets the needs of the foundryman on the one hand and is correct scientifically on the other hand. The Bureau of Standards in cooperation with the American Institute of Metals is considering the matter, and it has been hoped to bring about uniformity for the English-speaking countries through the cooperation of the British Institute of Metals and its allied societies; and possibly, at least as concerns some of the fundamental principles, international agreement may be reached through the active advocacy of the subject by the editor of the International Journal for Metallography.

Investigation of Molding Sands.

In cooperation with the American Institute of Metals, the Bureau has begun an investigation of the properties and methods of testing molding sands, with the object of finding out the characteristic qualities of such sands as have proved serviceable and endeavoring to put

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on a better scientific basis the classification of molding sands. A preliminary report will be presented at the fall meeting of the American Institute of Metals.

Pyrometric Standard Samples.

In response to numerous requests, arrangements are being made for the preparation, testing, and certification of certain pure metals of known and exactly determined melting points, such as tin, zinc, aluminium, silver, and copper, as pyrometric standards for distribution for the calibration of pyrometers. Several firms have offered to assist in furnishing such samples. The metallurgical and heat divisions will cooperate in this work.

Specifications for Metals.

The Bureau has received many verbal and written requests for copies of its specifications for various metals and alloys, and surprise is often expressed that the Bureau has no specifications of its own for these materials. There are many lines of specification work in metals which it would be highly desirable for the Bureau to take the lead in framing specifications which would serve as models for other branches of the Government service and elsewhere. This would require a considerable increase in the staff. Some of this work is, of course, now done in connection with committees of the several technical societies, but the work could well be systematized. As at present conducted, it is somewhat haphazard and accidental and often is not backed by sufficient experimental evidence such as the Bureau could furnish.

Cooperation with Manufacturers on Nonferrous Metals.

A very important feature of the work in metals at the Bureau has been the cooperation with manufacturers on nonferrous metals, including representatives of the American Institute of Metals, the American Chemical Society, the American Institute of Mining Engineers, the American Society for Testing Materials, and the American Electrochemical Society. Two well-attended meetings have been held during the past year at the Bureau, which has greatly aided in suggesting and mapping out lines of work, securing typical materials or samples, and obtaining the aid and benefit of the experience of many manufacturers for several problems in which the Bureau is interested. Very cordial and reciprocal relations have thus been established, which are of mutual benefit.

Metallurgy and Chemistry of Platinum-Group Metals.

Provision should be made for the study of the metallurgy and chemistry of the metals of the platinum group. This would require the installation of special furnaces and refining apparatus in addition to the chemical equipment, and the services of two or three men, one of whom should be skilled in platinum refining.

Systematic Investigation of the Properties of Metals.

Knowledge of the properties of even the more commonly used metals and alloys, especially at high temperatures, is very meager, and their determination requires, in many cases, elaborate and costly experimental arrangements and considerable skill.

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The Bureau is in receipt of many insistent and reiterated demands for many of these constants which can not be obtained elsewhere and which are needed in many lines of practical work. There is no way in which the metallurgical division of the Bureau could better serve the community than by inaugurating a systematic series of experiments on the determination of the physical constants of metals.

This work should be divided into two correlated classes—(1) the gathering and digesting of existing data, much of which exists only in private records, especially of some of the larger manufacturing companies (the Bureau should become a clearing house for the assembling and publishing of data thus made available); (2) actual experimental investigations by the Bureau.

That the country needs and expects the Bureau to take up this work on a more extensive and comprehensive scale than has been hitherto possible is evidenced by the fact that representatives of five of the principal scientific and technical societies have pointed out the necessity for such work, as have engineers separately. A resolution was passed by the iron and steel committee of the American Institute of Mining Engineers "that the Bureau of Standards be requested by this iron and steel committee to give attention to determining some of the lacking chemical and physical data concerning iron, more particularly the latent heat of fusion, specific heat in the liquid state, and heat conductivity up to the melting point, of pure iron and typical steel and cast iron."

It is also felt that such determination of physical constants when made by the Bureau will be unbiased, exact, and carry the weight of the authority of an impartial body of experts. This is an important phase of the matter, particularly when dealing with products that come into competition with each other.

Several manufacturers have expressed the willingness and urgent desire to furnish in quantity the pure materials required, such as zinc, aluminium, and copper, which would be especially purified for the purpose. A special fund should be provided for this purpose.

Aid Rendered the Public by Metallurgical Investigations.

Most of the investigations being made of metals have been undertaken at the request of technical societies, departments of the Government, railroads, manufacturing firms, or individuals; and in all cases the problems being studied are of general interest and represent endeavors to find answers to specific questions of considerable importance to large classes of people.

As examples may be mentioned the study of structural bronze and brass failures, which is of far-reaching importance in defining the proper use of and specifications for these materials, first undertaken at the instance of the board of water supply of the city of New York and the city of Minneapolis, and later with the cooperation of many manufacturers; the investigation of causes of failure of fusible tin boiler plugs, requested on behalf of the Steamboat-Inspection Service, but of interest to all users of boilers employing this safety device; and the determination of the quality of platinum ware, started at the request of the American Chemical Society, and of interest to all users of such material.

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Metallurgical Testing.

The following tests were completed during the year:

Name.	Heat treatment, thermal analysis.		Metallographic.				Fusible plugs.	Brass and bronze failures.	Miscellaneous.	Grand total.
	Non-ferrous metal.	Irons and steels.	Rail failures.	Identification method and process of manufacture.	Metal failures.	Miscellaneous.				
For the Government:										
Panama Canal	.....	2	.....	104	.....	.....	.....	.....	.....	.....
Bureau of standards	.....	45	.....	24	.....	.....	.....	.....	.....	.....
Miscellaneous	5	3	2	6	9	.....	1,063	.....	2	.....
Total	5	50	2	134	9	.....	1,063	.....	2	1,265
For the public	.....	38	.....	7	.....	13	.....	173	1	232
Grand total	5	88	2	141	9	13	1,063	173	3	1,497

Of these 1,497 test items, 1,265, or 85 per cent, were for Government departments. The Government tests were distributed among the Isthmian Canal Commission (106), Bureau of Standards (69), Steamboat-Inspection Service (1,062), Bureau of Lighthouses (5), War Department, Quartermaster General's Office (6), Interstate Commerce Commission (3), Naval Inspector of Ordnance, Philadelphia (3), and 1 or 2 each for the chief clerk's office, Department of Commerce; Naval Supply Depot, Brooklyn; Naval Gun Factory, Washington; Bureau of Mines; Superintendent, Capitol and Grounds; National Zoological Park; corporation counsel, District of Columbia; Post Office Department; and Supervising Architect's Office, of the Treasury.

Several of these tests, particularly of failed materials, necessitated elaborate researches, and will serve as the basis for publications concerning the various types of metal failures.

Information Furnished as to the Properties of Metals.

The metallurgical division of the Bureau has furnished by correspondence much information concerning the properties of metals, and has received many visits from representatives of firms desiring similar data. For example, in one month representatives of the following interests visited the Bureau to ask its advice: A watch company, concerning nonmagnetic and nonexpansible alloys; a steel company, on the improvement of rails with titanium; a brass company, as to metallographic methods; a car-wheel company, concerning railway materials and metallographic standards; a car-wheel company, in regard to chilled wheel design and service; a steel company, as to temperature control in the manufacture of ordnance; a brass company, concerning properties of nonferrous alloys, etc. Others have visited the Bureau to become acquainted with its methods

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of testing and research, among them representatives of railroads, steel works, universities, instrument manufacturers, etc.

Typical questions handled by correspondence have been the improvement of malleable iron, from a manufacturer; aluminium disease, from a farmer; paint for metals to stand 800° F., from an enameling firm; case hardening and composition for rock drills, from a mining company; bronze bearings for heavy grinding machines; alloy that can not be remelted at original melting temperature; fusible boiler plugs data, from manufacturers; strength of vanadium steel, from an engineer; cooling curves of ordnance steel, from an ordnance officer; suitable steel for guy rods; soldering of iron sheets; failure of locomotive boilers by cracking at seams; case hardening of machine steel; alumina in steel, from a steel company; properties of forged wrought iron; equivalence of Ni and Cr to carbon in hardening rails, from a railroad; numerous inquiries concerning foundry practice, both from iron and brass foundries; abrasion of metals; expansion of metals with time and temperature, from a railroad company; methods of manufacture of various alloys; melting points and heat treatments of steel; suitable metals for printing plates; cutting metals with metallic disks; suitable resistance wires; substitutes for zinc for various uses; metallic thermostats, from an instrument manufacturer; bearing metals for watches and for locomotive parts; properties of molybdenum, from a handbook compiler; composition of a white nontarnishing alloy, from a manufacturer, etc.

Metallurgical Publications.

The following publications have been issued during the year: Technologic Paper No. 38, on "Observations on Finishing Temperatures and Properties of Rails;" Scientific Paper No. 224, "Nickel Oxide;" Scientific Paper No. 242, "Measurements with the Micropyrometer;" Scientific Paper No. 249, "Iron Oxide;" Scientific Paper No. 236, "Electrical Resistance and Critical Ranges of Pure Iron;" "Progress in the Nomenclature of Alloys," published in the Transactions of the American Institute of Metals, Vol. VIII, p. 46, 1914; "Determination of Carbon in Steels and Irons by Direct Combustion in Oxygen at High Temperatures," published in the Journal of Washington Academy of Sciences, vol. 4, p. 393, 1914; "Sound Steel Ingots and Rails," published in the Proceedings of the American Institute of Mining Engineers and the Proceedings of the Iron and Steel Institute of Great Britain. Other papers in course of preparation and in press are "Characteristics of Radiation Pyrometers;" "A Study of the Quality of Platinum Ware;" "An Investigation of Fusible Tin Boiler Plugs;" "Standard Test Bars of Zinc-Bronze: 88 Copper, 10 Tin, 2 Zinc;" "Some Foreign Railway Specifications: Wheels, Rails, Axles, Tires;" "The Microstructural Changes Accompanying the Annealing of Bronze: 88 Copper, 10 Tin, 2 Zinc;" "Failure of Structural Brass;" "Preparation of Pure Iron and Iron Carbon Alloys;" "A Test of a Surface Combustion Furnace;" and "Methods of Testing Molding Sand."

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Structural Steel Column Tests.

An important investigation now in progress which is of value to the engineering and architectural professions consists of a series of column tests which the Bureau is making in cooperation with the steel-column committee of the American Society of Civil Engineers and the steel-column committee of the American Railway Engineering Association.

The series of the American Society of Civil Engineers comprises 9 different types of cross section. With one exception, 18 columns of each type have been fabricated for testing, 9 of light and 9 of heavier structural shapes. The 9 columns, both of the light and heavy kind, are made in 3 different lengths, so that there are 3 columns of each type and weight of section having the same length. During the progress of this investigation it was decided to extend this series of columns by 24 additional columns now being fabricated. These columns will be of the same types as those already furnished, but some will have different lengths and others will be made of heavier structural shapes.

The American Railway Engineering Society's columns comprise 18 latticed columns with rectangular bearing plates at both ends. Only one type of cross section but of two different weights of structural shapes has been tested. Both light and heavy columns are made in 3 different lengths, there being 3 columns of each length and weight of cross section. Thirty-six additional columns of this type, but modified in some single detail, are now being fabricated for the purpose of determining the effect of such modifications on the strength of the columns.

In addition to these column investigations, a large number of steel bridge columns have been tested in cooperation with prominent engineers. The columns are facsimiles of members from long-span bridges which are being erected or soon will be erected in America. The reports on the data and results of these tests, when completed, will be very valuable to bridge designers, as such data on large size columns have not been available before.

The purpose of these tests is to determine the best forms of cross-section of columns and also to correct or confirm the formulas used by engineers and architects for calculating the strength of columns. Not alone are such formulas valuable for determining the loads which can safely be carried by the columns used in various structures, but they also enable the designer of columns to make the most economical use of the steel employed in their construction.

Although the testing of these columns consumes much time, since it must be done very carefully in order to secure reliable results, this investigation has made good progress during the past year. More than three-fourths of the two series of columns have now been tested. The results of these tests show that with one exception the columns made of the heavier structural shapes fail at loads per square inch of cross section which are about 10 per cent less than those which produce failure of the columns of the same type but of lighter section. The work has not progressed far enough to admit of drawing any

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definite conclusions from the tests, and it may be necessary to again extend the present program of the investigation before arriving at a final interpretation of the results.

Tests of Large Columns for Long-Span Bridges.

Through the cooperation of several consulting engineers and manufacturers with the Pittsburgh branch laboratory, it has been possible during the last three years to carry to completion an investigation upon the strength and behavior of 18 large bridge columns when under loadings. The columns varied in size from 50 to 120 square inches in cross section, and were constructed of various alloys and high-carbon steels, some of the specimens being the largest ever tested. These 18 specimens corresponded throughout with certain top chord members selected from the following long-span bridges recently erected in America: The Municipal Bridge, at St. Louis; the Chicago, Burlington & Quincy Railroad Bridge, at Metropolis, Ill.; and the new bridge at Memphis, Tenn. In carrying out this investigation a study was made of the action of the columns as a whole to determine the relation of maximum loads to yield points of the grades of steel used. The elastic coefficients of the "built-up" members were found and the causes of initial strain induced in fabrication by the driving of rivets were analyzed. The laws affecting the distribution of stress and strain in the lattice, pin plates, and other details were studied with reference to the efficiency of these particular types of details used by their designers. Heretofore the inadequate capacities of American testing machines have imposed restrictions which prevented tests being made on large columns to the full maximum load at failure. Many of the present columns sustained from 3,000,000 to 6,000,000 pounds before collapse, and the derived data covering the behavior during tests will be of value to bridge and consulting engineers and manufacturers who are engaged in the construction of large railroad bridges. The research will also afford practical data for a proper formulation of the real mechanics of the column. These mechanics have in the past largely been based on purely theoretical considerations founded upon inductions made from the results gotten in the case of small laboratory specimens, there being but few systematic investigations previously made upon large columns of the type here considered.

Causes of Failure of Railway Materials.

The investigation as to the causes of failure of rails and other railway material has been continued during the past year. Numerous specimens of rails which failed in service have been received by the Bureau from several railway companies who offered their cooperation and assistance in this work. The failure of each of the specimens furnished was caused by the formation of transverse fissures in the interior of the rails and the Bureau is now endeavoring to ascertain under what conditions this type of failure is produced. Special shop equipment to facilitate the preparation of the specimens for the necessary chemical, microscopic, and physical tests has been recently installed. The results of this investigation will contribute toward safer railroad communication.

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Standard Test Specimen for Cast Bronze.

The investigation made by the Bureau at the request of the American Institute of Metals preliminary to the establishment of a standard test specimen for cast bronze has been completed. About 800 specimens were prepared from a typical bronze consisting of 88 per cent of copper, 10 per cent tin, and 2 per cent zinc, and tested for ultimate strength. The results of these tests taken in conjunction with the results of the investigation of the metallurgical division led to the adoption of a certain form of cast test specimen as a standard for such materials. (See also "Metallurgical investigations.")

Influence of Time in Testing Steel Specimens.

The investigation made by the Bureau in cooperation with the American Society for Testing Materials to determine the effect of the speed of application of the load on the yield point of a steel specimen in tensile tests has not yet led to any definite conclusion, the results obtained so far not being sufficiently concordant. The yield point is the load in pounds per square inch at which a flow of the metal occurs when subjected to tension or compression. The purpose of this investigation is to ascertain the best speed of applying the load when making commercial tensile tests of various kinds of steel.

Behavior of Spring Steel under Repeated Static and Dynamic Stresses.

Work has been continued on the heat treatment of 1 per cent carbon steel with special reference to the development of endurance to repeated stresses such as are met in service. The steel is being studied in the quenched condition as well as in its final state after being drawn. This work has brought out some difficulties, the solution of which it is hoped will advance our theoretical knowledge and improve the practice of heat treatment. This investigation has been carried on jointly at the Bureau and the Altoona shops of the Pennsylvania Railroad on certain locomotive springs which have been a source of considerable trouble up to the present time.

Calibration of Testing Machines.

It is desirable to test the accuracy of the reading of testing machines from time to time, especially during the course of a long investigation. With this point in view, the Bureau has secured apparatus for testing machines up to 50,000 pounds capacity and has undertaken the design and construction of apparatus with which it hopes to be able to standardize its own machines as well as those of the public to a point which lies as far beyond the 50,000 pound limit as may be necessary. Considerable progress has been made during the past year in this direction, so that the Bureau will soon be ready to standardize machines to 200,000 pounds capacity.

Information Regarding the Strength of Metals and Their Alloys.

Much assistance has been rendered by the Bureau during the past year in the form of answers to correspondents seeking information as to the strength and other properties of metals and on allied subjects. These inquiries were received from Federal Government de-

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partments, municipal and State governments, universities and schools, engineering societies and research laboratories, corporations, and private individuals.

The inquiries relate to a wide range of subjects. Many were requests for technologic papers issued by the Bureau and sources of engineering literature printed elsewhere. Specifications for various materials, such as pipes, steels, hard-drawn copper bars and wires, hardware, tools, timber, materials for machine parts, and helical springs were often requested and on several occasions the Bureau was asked to interpret the existing standard specifications for materials and methods of tests. The Bureau's opinion has been frequently sought regarding the feasibility of various new devices, such as waterproof piles, devices for pneumatic riveting, and welding joints. Inquiries have been made concerning the testing machines, methods of testing, and kinds of testing apparatus needed for particular purposes. Information as to the cause of failure of manufactured materials has been the basis of many requests.

Tests on the Strength of Materials.

The test of compression and tensile strength, transverse bending strength, and hardness made at the Washington laboratories were for practically all departments of the Government. Over 200 tests were made on ferrous metals. These tests included, besides the usual specimens of different steels, tests of a jack cable reel, steel and galvanized iron wires, shafting, rollers, horseshoes, rail specimens, screw-box collars, header test bars, cast and malleable iron bars and bolts. One hundred and eighteen tests of nonferrous metals were made, such as bronzes and brasses, monel metal, bronze sash chains, and copper wires and plates and aluminum bars; 28 tests of sundry materials, such as porcelain insulators, vulcanized fiber, micanite, glass rings, and timber; compression tests of two large 10-inch glass cubes used for the insulation of radio towers, and tensile tests of 15 hemp ropes have been made. Besides, more than 300 pieces of structural steel for two Federal buildings, now being erected, were inspected; 5 testing machines having capacities of 100,000, 200,000, 400,000, and 800,000 pounds, the last being the Emery machine at the Watertown Arsenal, were calibrated or compared with the Bureau's machine; 3 jackscrews were tested for lifting capacity and 3 large bridge columns for ultimate strength.

Numerous tests of a general routine nature at the Pittsburgh branch were made for various departments of the Government and for manufacturers or individuals, these covering 290 tests of manila rope ranging in diameter from one-half inch to 3½ inches, 25 tests of wire cables, a number of tests of porcelain insulators for wireless transmission towers, and numerous miscellaneous tests upon steel and iron bars, granite blocks, as follows:

In connection with the work of the cement division, there were made 750 tests upon standard 6-inch concrete cylinders, 100 6-inch cubes of concrete, and 1,350 tests of 2-inch cement cubes. There were made numerous tests for manufacturers, these consisting of 12 tile walls, 6 feet long and 10 feet in height, both transversely and under compression; 4 transverse tests on street-car rails to determine efficiencies of various methods of electric welding, and a number of

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tests of brick of various types. Four large hydraulic jacks of 40 internal diameter to be used in connection with the erection of long-span bridges were tested under proof loads to determine the action and efficiency of the cylinder packing rings. Twelve car couplers were tested under proof loadings, and a number of miscellaneous tests, aggregating about 100 specimens, were made on specimens of steel for rolls, cast-iron specimens, granite and limestone cubes, hollow tile, flexible casing for lamp cord, etc.

Standard Specifications for Portland Cement.

Meetings of the joint conference of representatives of the United States Government, the American Society of Civil Engineers, and the American Society for Testing Materials were held during the year and final agreement was reached on one specification for Portland cement which was recommended to all three organizations for adoption. If this specification or a modified form is finally agreed upon, it will result in one recognized American standard instead of several as at the present time, with its attending advantages to the cement industry as well as the engineer. The recommended specification includes several modifications from previous existing specifications which it is believed will furnish a cement of improved quality. The United States departmental conference on cement specifications, which was organized by the Bureau of Standards, will probably take action upon this specification during the ensuing year.

Hydraulic Cements Other than Portland Cement.

In the investigations under way dealing with Portland cement it has been necessary to determine the properties of the silica-alumina-lime compounds other than present in normal Portland cement. The result has been the finding of some very interesting lime-alumina compounds which developed very hard dense mortars which have a very high strength at early periods. The introduction of moderate amounts of silica and iron oxides into these serves to increase still further the high strengths which are obtained in compression, and also results in the production of ternary compounds which seem to have hydraulic properties of considerable value. A survey of these less known and seldom used compounds has been but preliminary, although the results have justified further work which was carried on at the Pittsburgh branch during the year with burnings made in the rotary kiln.

Further Studies of the Hydration of Portland Cement.

There was published during the past year a paper on the Hydration of Portland Cement. This represented the results of an investigation, carried on largely during the previous year at the Pittsburgh branch, dealing with the products of the hydration of the constituents of Portland cement clinker. There was no quantitative relation established between the products of hydration and the strength produced. During this year, however, the constituents ordinarily present in clinker were prepared, after much difficulty, in sufficient amounts to make sufficient tensile specimens to allow breaking at periods as late as one year. These constituents were tested, not only alone, but when mixed in about the proportion as found in normal

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cements. Furthermore, the rate of hydration was followed by frequent microscopical examinations and the amounts of hydration determined by determinations of the amounts of water chemically combined. The results obtained confirm in almost every detail the deductions and predictions made in the paper already issued.

Clinkering Temperature of the Raw Mixes Used by Portland Cement Manufacturers.

Owing to the nature of the flame used in the manufacture of Portland cement, it is almost impossible to determine the temperature at which the raw mix is heated to clinker. This flame is in the nature of a cone surrounded by partially burning coal dust which almost entirely obscures the clinker at the hottest part of the kiln. But the temperature at which the proper combination of the various elements of the raw mix takes place is of great interest, especially when considered in connection with its lowering or raising produced by changes in composition. Seventy-three raw mixes have been burned at the same temperatures and the resulting clinker examined. This data is now being examined in connection with the composition of the mixes. There is also being made the melting (softening) point of these mixes. This work is being carried on with the Pittsburgh branch laboratory experimental kiln.

The Effect of Varying the Composition of Raw Mixes Used in Portland Cement Manufacture.

One of the more comprehensive studies of the Pittsburgh branch of the Bureau of Standards is determining the effect on the general properties of Portland cement of changes in the composition, which carries with it the determination of changes in the kind and amounts of the various constituents normally present. In this investigation 74 different cements have been made in the experimental plant of the Bureau. These have been examined petrographically, chemically, and their strength producing properties determined—as neat cements, mortars, and concretes. The 180-day specimens of all the cements have been broken, and consequently it will be possible to publish the results of the investigation, though specimens have been made for much longer periods which will entail the issue of the supplemental papers.

There have been included in this investigation three series of burnings, of which it is thought advisable to issue the results separately. One of these deals with white Portland cements, which differ from normal cements largely in their very low iron-oxide content. To make the investigation a little more comparative, there will be included some results obtained from burnings of very low alumina and high iron-oxide content.

The other two series deal with the important matter of the magnesia content of Portland cement. In these series there are burnings of cement of very low magnesia content and of a content as great as 25 per cent. It may not be anticipating too much to say that the limits for the magnesia content as specified in all standard specifications are well within the amounts which produce any injurious effects.

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Suitability of Various Clays, Limestones, etc., for Making Portland Cement.

There are frequent demands made upon the Pittsburgh branch of the Bureau for the rendering of an opinion in regard to the availability of various materials for the manufacture of Portland cement. However, the Bureau has not yet made any detailed investigation of this character for the public, since when the inquiry is answered by a general statement in regard to the cost of building a new cement manufacturing plant and placing a new brand upon the market no further information is wanted. It is not generally understood that a deposit of raw material sufficiently large to last for 20 years for a plant turning out not less than 1,000 barrels per day—which is the smallest plant unit that would make adequate returns on the investment—is absolutely necessary. The deposit should also be examined carefully by a geologist to determine its uniformity in composition, since lack of this would produce excess cost of manufacture and other difficulties resulting in a lack of uniform cement. While the Bureau is very willing to make trial burnings of raw materials, it advises first a careful survey of the deposit, the determination of the likelihood of interesting sufficient capital in the proposition, and a survey of the neighboring market.

Investigation and Testing of Cement, Concrete, and Stone.

The work in the cement section is of three kinds:

(*a*) The determination of the physical properties of cements, concretes, sands, crushed stones and gravels, building stones, plasters, drain tile, the investigation of the durability of these materials under various conditions, and the investigation of testing methods.

(*b*) Special investigations of the above and other similar materials at the request of Government offices to determine as to whether they are satisfactory under special service requirements.

(*c*) The testing of samples of cement submitted by various Government offices to determine as to whether the cement meets the requirements of specifications upon which it is purchased, together with sampling of cements at the point of manufacture and supervision of shipments under Government seal.

Durability of Concrete in Alkali Waters.

This investigation was started in 1913 and was instituted because of its importance to various branches of the Government using concrete in irrigated districts, where the alkali occasionally becomes concentrated in the soil, and as a result of the many requests received for information on the subject. The investigation is conducted in cooperation with the Reclamation Service, the drainage division of the Department of Agriculture, and the Association of American Portland Cement Manufacturers to determine the durability of concrete of various kinds in concentrated alkali soils and methods of mitigating failure. As part of the investigation some 8,000 specially prepared drain tile made under the Bureau's supervision were installed in concentrated alkali soils in Colorado, Montana, Wyoming, Arizona, Washington, New Mexico, and Utah. The results of the first year's tests published in Technologic Paper 44 show that concrete will disintegrate in some of these soils unless the

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best of materials are used and special care is exercised in the fabricating of the concrete. Additional tests are to be made from year to year and the report amended as results are available. As an extension of this work short concrete columns are to be fabricated and installed during the ensuing year on projects in Colorado, Wyoming, Nevada, South Dakota, Montana, and New Mexico. These are made under various conditions and are to be inspected after exposure for various periods.

Standard Cement Sieves.

As a result of the further investigation of the standard 200-mesh sieves results of which were published in Technologic Paper 42, it was found desirable to change the specifications for standard sieves and require a given uniformity when tested with a standard fineness sample. This modification of specifications has benefited the testing laboratory by insuring greater uniformity of results.

Standard Fineness Sample.

As a result of requests for a standard fineness sample which could be used by laboratories for checking their sieves and operators, an investigation was made of the suitability for this purpose of various materials, such as ground quartz, alumina, burned clay, cement, etc. This investigation resulted in the adoption of such a sample which is now available to the public in two grades. There has been considerable demand for these samples since their preparation in December, 1914.

Effect of Fine Grinding of Portland Cement.

There has been much discussion as to the value of fine grinding of cement, the tendency being to require finer grinding, although little is known as to its effect. On this account it has been deemed advisable to investigate the effect of the fineness of cement on its strength and other physical properties.

In connection with these investigations it was necessary to develop an apparatus for the purpose of separating in quantity the "flour" of Portland cement from the coarser particles. Three grades of fineness are being obtained with the separator, the coarsest of which readily passes the 200-mesh sieve. Several brands of Portland cement are also being reground to various degrees of fineness to be tested in concrete. It will probably be a year or more before conclusive results will be available.

Granular Analysis of Cement.

Investigations have been continued with the granulometric analyzer. Much work has been done with the object of making the analyzer more compact and convenient for laboratory use. The proper shape of bulb, the effect of abrasion of particles on the results of analyses, effect of differences in specific gravity of cements on the sizes of particles blown off and the least height of stack that may be used, were investigated. In connection with the specific gravity and height of stack investigations, more than 10,000 cement particles were measured with the microscope. The results of these investigations have been reported in Technologic Paper 48.

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In addition to work done with the analyzer as a part of the programs of investigations by the Bureau of Standards, work has also been done in connection with investigations by several cement companies.

"Flour" determinations have been made on samples of litharge, red lead, hydrated lime, ground sand, etc.

The air analyzer may be said to supplement sieve determinations of fineness, being capable of producing much finer separations than those obtainable with the 200-mesh sieve. On account of the lack of uniformity in the size of openings of the 200-mesh sieve the determinations by the air analyzer are more accurate as to the limiting size of particle in each degree of fineness obtained.

Stucco and Plaster Investigation.

A series of tests, primarily to determine the comparative durability of various types of plastered metal lath on exterior walls, was undertaken in 1911. The results of these tests, obtained from the exposure of small panels, indicated the necessity of carrying out an investigation on a much larger scale. Accordingly a new and more comprehensive series of tests was planned, the program of which was put into the hands of an advisory committee consisting of representatives from the Government, engineering societies, the Associated Metal Lath Manufacturers, the Association of American Portland Cement Manufacturers, the Gypsum Industries Association, the National Lime Manufacturers Association, the Hollow Tile Manufacturers Association, and a number of plastering contractors. The recommendations of this committee have been followed in the execution of a test structure, approximately 200 feet long, 26 feet wide, and 24 feet high, the exterior walls of which are divided into 56 panels approximately 15 feet wide and 10 feet high. These panels are being constructed of terra cotta hollow tile, monolithic concrete, brick, gypsum block, plaster board, and wood and metal lath, and will be plastered with a number of typical stuccos. The work will be carried out under the supervision of the advisory committee, and it is anticipated that the finished panels will represent the best examples obtainable of exterior stucco construction. The stucco panels will be completed in the fall of 1915; later the interior of the structure will be available for tests of interior plasters on walls and ceilings. Results will not be available for a year or more.

Effect of Moisture and Temperature Changes on Concrete.

Work was continued on the investigation of the action of concrete when subjected to a variation of temperature and moisture conditions. The present work has been confined to making strain-gauge measurements on concrete roads and pavements with the ultimate aim of determining the most effective distance for the spacing of transverse joints in concrete. The results obtained show that changes in the moisture content of the concrete has greater effect upon the volumetric expansion or contraction than the normal atmospheric variation in temperature between seasons. The maximum expansion of concrete occurs in the early spring and maximum contraction in midsummer. Further measurements will be needed to determine the absolute quantitative effect of moisture and temperature conditions.

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Strength of Reinforced Concrete Structures.

An investigation of full-size concrete structural members of various design to establish the laws governing their behavior was inaugurated. An advisory commmittee has been organized, composed of prominent engineers expert in concrete design, to act with the Bureau in the execution of the program. A thorough and exhaustive series of tests will be made on numerous full-size members of reinforced concrete construction in the form of both individual and composite structures. The work is in a formulative stage and no results are yet available.

Value of the High-Pressure Steam Test of Portland Cement.

The investigation of the value of atmospheric and high-pressure steam tests as a means of determining the soundness of Portland cement has been continued and the results available to date have been published as Technologic Paper 47. This test has been exploited during the past few years by some engineers and widely discussed in the technical press. The results obtained to date indicate that cements meeting the requirements of this test are no stronger or more durable when employed in concrete under normal conditions than cements passing the present standard cement specifications but failing to pass this test.

Physical Properties of Sand-Cements (Silica Cements).

During the past two years a study of the physical properties of several sand cements has been made. This work was continued this year and the results to date have been collated and will be published in the near future. Cements of this character have been extensively used on Government work. The tests to date indicate that concrete containing sand cement as the binding material is inferior in strength to concrete containing the same amount of standard Portland cement. The difference in strength of the two concretes becomes more marked as the ratio of the cement to aggregate decreases.

Value of Various Materials as Concrete Aggregate.

In cooperation with State geologists and others, representative samples of mine tailings, crushed slag, sands, gravels, and stones are being obtained for test to determine their suitability as aggregate for concrete mixtures. Many inquiries are received concerning the value of these materials. Results of the investigations will probably be published in State reports and subsequently in Bureau papers as the results accumulate.

Compressive Strength of Portland Cement Mortars and Concretes.

A study was completed of 20,000 tests of Portland cement mortars and concretes collated from the many investigations made by the Bureau of Standards and the structural materials laboratories of the Geological Survey, which were transferred to the Bureau of Standards in 1910. The results show that several of the generally accepted methods for proportioning concrete mixtures are incorrect and that certain precautions are necessary in the fabrication of concrete to ensure a product of known quality. The effect of variation

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in the quantity of cement used, the effect of different exposures while hardening, the effect of aging, etc., is discussed. The relative value is shown of various aggregates such as gravels, limestones, granites, trap rocks, cinders, sands, and stone screenings, also the relative value of rounded and sharp-grained sands. Proper methods for testing and selecting aggregates are also suggested.

Effect of Sea Water on Concrete.

The investigation of the effect of sea water on concrete has been continued by inspecting many concrete structures along the Atlantic and Pacific coasts of the United States, the coast of Nova Scotia and New Brunswick, by careful investigation through physical examination and tests of structures which had failed, and collating information on the condition of concrete structures exposed to sea water in various ports of the world. These data are being obtained through the various consular agents, and reports have been received on a large number of structures. It is anticipated that during the ensuing year a report will be prepared showing the conditions under which concrete should be used in order to have permanency under sea-water exposure. The results of this investigation will be of value to the Government and all engineers interested in marine construction.

Fusion of Concrete.

The Bureau was asked to investigate the reported fusion of concrete in a burned building. Since the fusion of concrete had never been observed under such conditions, an investigation was made. It was found that the concrete had apparently fused in several of the buildings where the fire was known to have been of exceptional severity and long duration. Laboratory investigation upon samples of unexposed concrete from the same buildings showed that the concrete would fuse at a temperature of approximately 1,240° C. This comparatively low fusion temperature was due to the trap-rock aggregate. It was evident from the melted steel that temperatures were obtained in portions of the buildings well above that required to cause fusion.

Dusting of Concrete Floors.

Experiments have been started to determine a suitable material for treating the surface of concrete floors to prevent dusting and increase their durability. This work is part of a more comprehensive investigation which is now being outlined to determine proper methods of construction which will mitigate dusting. An abrasion machine has been designed for testing flooring materials which it is believed will give results comparable with the actual wear on floors, and plans have been made for extensive tests on various flooring materials. Results of this investigation probably will not be available for a year or two.

Investigation of Concrete Aggregate for Panama Canal.

A rather exhaustive series of tests was made of the aggregate at present used in the concrete work on the Panama Canal. Due to a decrease in the demand for material of this character on this project, it was planned to eliminate all but one of the plants producing concrete aggregate, but it was desired to retain that one which produced

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the material yielding the most dense and strongest concrete. With this in view several tons of the available aggregates were submitted to the Bureau and tests were made, with the result that it was recommended to employ Ancon crushed stone and screenings. Experiments were also made on concrete containing crushed rock up to 4 inches in size, and it was found that material of this kind increased the amount of inert material that could be added to the same amount of cement without impairing the strength of the resulting concrete.

Development of an Accelerator for Hardening Concrete.

At the request of the United States Engineer Office at Memphis, Tenn., an investigation was made to develop a method of producing a concrete which would have considerable strength in a comparatively short time. A concrete of this character was desired as a substitute for willow mats for use in revetment work on the Mississippi River. The decline in the supply of willows available for this purpose necessitated the finding of a suitable substitute. A large number of experiments were made and results that are promising have been obtained. It is contemplated to continue the work along the present lines and publish the results in the near future.

Stone Investigation.

In connection with the cooperative investigation of building stones, machinery has been installed for cutting and grinding test pieces, and representative samples of stone have been collected, in cooperation with the Geological Survey and Bureau of Mines, from 80 quarries. Thirty samples of marble and limestone and 86 samples of other stones, totaling 2,784 specimens, have been tested to determine compressive, tensile, transverse strength, on edge and bed, specific gravity, absorption, hardness, staining quality, and resistance to frost action.

A card-index system for filing stone records has been worked up and all available tests made at this Bureau and other laboratories have been collated and filed therein for ready reference. A paper containing the available data will probably be prepared for publication during the ensuing year.

Investigation of Fire Protection for Steel Columns.

The Bureau has cooperated with the Underwriters Laboratories in developing the program of fire tests of various types of steel columns under load. Preliminary designs of protective coverings were prepared and tentative suggestions made as to the concrete and mortar mixtures and materials to be used. Several conferences were held and further assistance rendered in the development of the final program. This investigation contemplates tests of a large number of full-size structural steel columns, protected by commercial coverings such as concrete in various forms, tile, and gypsum. The tests will probably be made during the ensuing year.

Investigation of the Fire-Resisting Qualities of Partition and Supporting Walls.

Designs were completed for the construction of a testing plant including a furnace and 12 panel frames for making fire tests of partition and supporting walls. The frames are heavy steel I-beam and plate sections 17 feet long by 13 feet high and will accommodate

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a wall 12 by 16 feet up to 12 inches in thickness. The furnace is designed to have a temperature uniformity within 40° for any two points on the wall for temperatures between 1,400° and 2,500° F. The testing plant will also be provided with fire pump and equipment to give a water stream up to 80 pounds per square inch pressure through a 1½-inch nozzle. Most of the equipment has been ordered and part of the construction work completed, but the plant will not be ready for operation until about January, 1916.

The Value of Tufa Rock and Volcanic Ash as a Material for Admixture with Portland Cement.

At the request of the United States Engineer Office at Honolulu, Hawaii, an investigation was started to determine the suitability of certain tufa rock and volcanic ash, found in that territory, for use as a material to be mixed with Portland cement to produce a cheaper but satisfactory cement for building purposes. The materials have been received and the tests are in progress. It is expected that a report of these tests will be published during the coming year.

Investigation of Integral Waterproofing Compounds.

In 1912 a number of cement stucco panels approximately 3 by 12 feet in size were erected in which various integral waterproofing compounds were incorporated. These panels have been exposed to the weather and observations made from time to time. Their present condition indicates that none of the so-called integral waterproofing compounds have appreciable value; some of them are deleterious and cause cracking and disintegration. About 10 per cent by volume of hydrated lime appears to appreciably decrease the water absorption property of the stucco and has no deleterious effect. This work is being continued by the erection of several large panels containing waterproofing compounds in connection with the general stucco investigation. Plans have also been formulated for the organization of a committee to outline a comprehensive series of tests on the integral method of waterproofing against water pressure. Many inquiries are received on this subject and it is of much concern to all users of cement.

Routine Cement Inspection and Testing.

Cement was inspected during the year at 12 different cement mills located in Virginia, Maryland, Pennsylvania, and New Jersey. The inspection work included the taking of samples, their testing, and subsequent inspection of packing and shipping. A total of 10,125 samples were tested for the Navy and War Departments, Bureau of Lighthouses, Panama Canal, Supervising Architect's Office, District of Columbia, Lincoln Memorial Commission, etc. Inspection was made of 480,808 barrels of cement for shipment to Panama and 207,877 barrels for shipments to Government departments in the United States, for use in the construction of Federal buildings, river and harbor improvements, etc.

Cement was inspected for three companies for the Government of Argentina. This included the sampling and testing of 91 samples, approximately 51,400 barrels. It was necessary that this cement

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should pass the United States Government specifications for Portland cement before it could be accepted by the Argentine Republic.

At the Pittsburgh branch laboratory the routine testing of cement for the public has been very slight; but for Government uses it has been so great that it was necessary to place local inspectors at three different plants, who take charge of the sampling and shipping alone, the actual testing being done as usual at the laboratory. It is gratifying to note that the quality as furnished has improved very markedly. Thus, out of 329,000 barrels sampled, it was necessary to reject only 14,600 barrels. During the previous year it was necessary to return to the manufacturer more than twice this amount.

Miscellaneous Investigations and Tests.

A total of 306 samples were tested consisting of sands, screenings, gravels, stones, asbestos roofing boards, sand-lime brick, gypsum, magnesite cements, composition flooring, concrete, cement accelerators, etc.

Twenty-three commercial waterproofing compounds were tested for the Lincoln Memorial and Arlington Memorial to determine their efficiency in preventing moisture and stains from penetrating the pores of marble. Six samples of marble were submitted to abrasion tests to determine the one most suitable for use in the floor of a building which had a floor failure due to severe service. Four commercial types of composition flooring were tested for the United States Marine Corps to determine their suitability under special conditions. Three samples of sandstone were investigated to determine their resistance to fire.

Information Furnished as to Cement and Concrete.

Many inquiries were received during the year from architects, engineers, contractors, and builders who sought information concerning methods of waterproofing concrete, the value of waterproofing compounds, methods of construction to be employed in sea water, effect of using sea water for mixing concrete to be placed in sea water, physical properties of concretes of various mixtures, the cause of staining of plaster walls and ceilings, the relative value of various concrete aggregates, the cause of failure of magnesite composition floors, methods of preventing the dusting of cement floors, methods of designing concrete road slabs, suggestions for building code requirements, durability of cement drain tile, the physical properties of marbles, specifications for stucco, fire-resisting properties of structural materials, the corrosion of metal lath, reinforcement of gypsum plasters, etc.

From the general public requests were received for information on methods of mixing concrete, laying of concrete sidewalks, waterproofing basements, suitability of various materials for use in concrete, durability of concrete in sea water, durability of composition magnesite floors, the physical properties of stones, the cause of failure of drain tile, the effect of frost action on concrete, suitability of concrete for oil and acid storage tanks, quality of American Portland cements, dampproofing brick and tile walls, dusting of concrete floors, corrosion of metal lath, etc.

From cement manufacturers, architectural stone manufacturers, commercial testing laboratories, requests were received for informa-

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tion on the accuracy of sieves, the physical properties of concrete, the value of fine grinding, the value of silica cements, cause of failure of drain tile, the interpretation of cement specification, value of sieve agitating machines, quick hardening concrete, standard fineness samples, standard methods of testing, etc.

Publications on Cement and Concrete.

The following papers were prepared during the year: Technologic Paper 42, "Standardization of No. 200 Cement Sieves;" Technologic Paper 44, "Investigation of the Durability of Cement Drain Tile in Alkali Soils;" Technologic Paper 47, "The Value of the High-Pressure Steam Test of Portland Cements;" Technologic Paper 48, "An Air Analyzer for Portland Cement;" and Technologic Paper 58, "The Compressive Strength of Portland Cement Mortars and Concretes."

The Purification of Clay.

It has been shown that very small amounts of caustic soda, carbonate of soda, and silicate of soda contained in the water employed in washing clays bring about a sharper separation of the clay and its impurities. The process has been installed in one plant and is being tried out by others. The product thus purified is superior in quality to that obtained by the usual process.

The object of increasing amounts of the same reagents in reducing the quantity of water used in casting slips has been worked out for a number of American clays. A simple efflux tube for determining the fluidity of slips used for casting clay wares has been designed. In this manner the addition of the chemicals can be controlled in factory practice.

The striking effect of sodium-oxalate additions to Florida kaolin in reducing the water content have also been studied.

Porcelain from American Raw Materials.

Experiments conducted both from the laboratory and shop standpoint have demonstrated, first, that the domestic kaolins can be purified so as to result in ware of excellent whiteness and, second, that from American kaolins, ball clays, feldspar, and flint a high grade of chemical porcelain, as well as of hard fire table ware, can be produced. Cooperation was carried on with a number of American pottery plants.

American Raw Materials Replacing the Imported Glass Pot and Crucible Clays.

An exhaustive study of some 15 imported and more than 100 domestic fire clays carried on in cooperation with manufacturers of glass pots has been carried on during the past year. The distinctive properties of the foreign clays were clearly defined and it was sought to replace them by mixtures of American clays. It was shown that while no single American clay found so far possessed all of the qualities of the best European plastic materials satisfactory results can be obtained by the use of a mixture of several domestic clays. The present work demonstrates that the importation of clays for the purposes of the glass and crucible industries is unnecessary, since there

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is a considerable number of excellent clays in Missouri, Kentucky, Tennessee, Pennsylvania, New Jersey, and Illinois available for this work.

Mixtures of Easily Vitrifying and Refractory Clays with Reference to their Rate of Vitrification.

In many industrial plants it is necessary to oppose the rapid vitrification of a readily fusible clay or to accelerate it when an inherently more refractory material is used. Work which was done with mixtures of clays representing the opposite types and the extent to which they interact and modify each other was demonstrated.

Vitrification of Clays and Electrical Conductivity.

It has been shown that the softening and partial fusion of clays when being fired is coincident with a marked increase in electrical conductivity.

Softening of Porcelain at Kiln Temperatures.

Previous work along this line has been continued and completed. The specimens which have passed through the often repeated heat treatment are being studied microscopically, since they approach equilibrium conditions very closely. The universal constitution of porcelains will thus become known.

Enamels and Colors.

Owing to the failure of the European supply a number of color and enamel compositions for clay ware and glass have been prepared and placed at the disposal of makers of such material.

Enameled Iron and Steel.

A suitable furnace has been erected and work has been begun on the study of metal enamels with special reference to enamel coating resistant to chemical reagents and to abrasion.

Optical Glass.

This country is entirely dependent on Europe for the supply of glass used in the manufacture of all kinds of optical goods. For this reason the study of the manufacture of optical glass was begun. Suitable furnaces and apparatus were installed. The work is now under way, but no completed results can as yet be reported.

Properties of Halloysite.

A peculiar clay-like mineral occurring in southern Indiana in large quantities, called indianite, a modification of halloysite, was examined with regard to its physical properties and composition. It was found suitable for the manufacture of high-grade refractories and appears to be adapted even to pottery making.

Silica Brick.

The properties of silica brick used in furnaces are being studied with special reference to their permanent expansion and change in crystalline structure.

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Testing of Fire Bricks.

In cooperation with the American Gas Institute and the American Refractories Association considerable work has been done in testing the resistance of fire clay products used in gas and coke oven plants to high heats and to loads at furnace temperatures. This information is to be used in working out specifications for refractories used in such important industrial plants.

Hollow Building Tile.

During the past two years a study of the physical properties of tile have been made in cooperation with manufacturers. Numerous experiments have been conducted to find the relative resisting power of different size tiles. The elastic coefficients have been determined in several hundred specimens, chiefly in order to determine the amount of variation that may be expected in the modulus (the ratio of load on tile to its compression under load), this information being desired by engineers in connection with the designing of tile walls and the ultimate loads on different grades and shapes. The relative efficiencies with respect to loading for different arrangement of bracing webs have been determined, and the comparative advantages of laying tile in different position in walls have also been studied. Some experiments were carried out to find the relative stiffness of different walls against lateral pressures, different types of wall construction being used, the walls always being of sizes comparable to those used in practical construction.

Experiments on Strength of Large Brick Piers.

This investigation has been conducted in cooperation with the National Brick Manufacturers' Association to determine the physical properties of large brick piers when under various loadings up to failure. The brick for the piers were selected in such a way as to be representative of the manufacturing output of the important geographical districts east of the Mississippi; these being the eastern district, covering New York and adjacent territory; the Pittsburgh district, covering western Pennsylvania and Ohio; the Chicago and Galesburg districts; and the southern brick manufacturing belt. Vitrified, hard, and common brick were used in the piers and they were laid up in various kinds of mortar, chosen to be representative of engineering and architectural practice. The piers were 2½ feet square and 10 feet high. The elastic constants of the piers were determined and a study made of the causes which most influence failure with respect to the grade of brick, type of mortar, bond, manner of laying the brick, and age of pier, with a view to defining the best load-carrying efficiencies of actual piers used in modern practice. Numerous supplementary tests are being carried out on the individual brick to determine independently their physical properties. These included a series of tests to determine the ratio of the strengths of bricks tested flat to those tested on edge. In this series three grades of bricks were used, one half of these being tested flat, the other half on edge, making a total of 90 individual tests. Thirty of the large piers have already been tested.

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Investigation of the Resisting Power of Soils.

A cooperative investigation has been taken up the past year conjointly with the committee of the American Society of Civil Engineers to determine the resisting properties of soils under the various conditions which arise in engineering practice. Numerous factors are presented in connection with the design of foundations and retaining walls, the bearing power of piles, the influence of which properly can usually be determined only experimentally by laboratory methods. Another class of factor arises in connection with the investigation of the laws of flow of plastic materials, as in the case of clay-working plants, or in the phenomena connected with the flow and pressure of grain in elevators. A still further class of phenomena presents itself in connection with the laws of controlling the movement of large masses of earth, as in the case of avalanches, or in the engineering problems of subsidence of earth, the action of freezing in forcing over large walls, etc. The experiments thus far conducted have been largely for the purpose of determining to what extent this branch of investigation will lend itself to laboratory methods, as against the use of statistical methods or judgment applied to field observations, such as has largely been done in the past by many engineers. Various physical coefficients are being found in these connections for different media which simulate actual earths, such, for example, as the density in relation to the pressure, the coefficient of frictions between the earths and bodies "immersed" in them, and the ratio of induced lateral pressure to vertical pressure, with a view to determining what practical range may be expected in these coefficients when the experiments are repeated, either under identical conditions or otherwise. The purpose ultimately is to secure definite data for applying to problems of engineering design after a suitable practical classification of known earths has been determined.

Cooperation with Technical Societies and Institutions.

The Bureau cooperates with technical organizations and educational institutions by contributing papers and articles to their transactions and assisting in giving short industrial courses for the benefit of manufacturers. Very close cooperation is being maintained with the National Brick Manufacturers' Association in the testing of large brick piers, with the American Ceramic Society, the American Society for Testing Materials, the National Paving Brick Manufacturers' Association, and a number of State organizations.

Information as to Clays and Clay Products.

Requests for information come from a large number of present and prospective manufacturers, and in many cases personal visits are made at the laboratories with specimens of raw materials or finished products. This phase of the work is growing more and more in scope and volume. In unusual cases trips have been made to the plants at the expense of the manufacturers.

Clay Testing.

A considerable number of clays have been tested and particular attention was paid to deposits which seemed to be promising raw materials for the pottery and refractory materials industries. Koa-

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lins, plastic clays, shales, and surface clays were tested, coming from Florida, Tennessee, North Carolina, Texas, Georgia, Alabama, Missouri, Illinois, Pennsylvania, Maryland, Ohio, Indiana, and other States.

Testing of Clay Products.

Physical tests of fire bricks, building tile, building and paving bricks, and electrical insulators have been made throughout the year in considerable numbers for Government departments, particularly the Panama Canal, as well as for the public at large.

Method of Measuring Plasticity of Lime.

Plasticity is by far the most important property of lime, frequently governing not only the use but also the price of the material. It is therefore extremely important that some method of testing for this property be established. Following the theory for the behavior of plastic bodies under load, a method of test has been developed and a machine designed and built for the purpose. The lime to be tested is mixed with the proper amount of water to form a putty and molded. The mold is immediately removed, and sufficient load is applied to the specimen to cause rupture. The rupture occurs along certain well-defined planes. Measurements of the angle which these planes make with the vertical, and of the load applied, give sufficient data to substitute in Merriman's formulas. The values of the "coefficient of internal friction" and of the "coefficient of cohesion" can now be calculated. The first tells whether the lime is sticky or sandy, the second whether it can be spread out into a thin coat or will tear easily under the trowel. The method has been applied to a large number of samples of hydrated lime, with satisfactory results.

Improvement of Plasticity of Hydrated Lime.

If hydrated lime is mixed with water, the putty formed will not be, in general, so plastic as that made from quick lime. This lack of plasticity is due to the presence in hydrated lime of what is known as "burned hydrate." This material differs physically, chemically, and optically from hydrated lime. The evidence at hand leads to the belief that it is a basic hydrate, which can be formed either during the process of hydration, when the lime may not be given a sufficient amount of water; or, the heat generated may be sufficient to decompose partially the hydrate which has already been formed. Attempts are being made to eliminate the production of this material by changing the design of the machine used for hydration.

Bonding Material in Sand-Lime Brick.

Sand-lime brick consists essentially of sand bound together by a compound of lime and sand which is formed by the action of steam. This compound has been loosely designated as a "hydrated calcium silicate." Since the properties of the brick depend largely on the behavior of the bonding material, it is desirable to know just what this substance is and how it will be affected under different conditions. The material was prepared by mixing pure lime and pure silica in the proper proportions and treating them with steam under high pressure. The resultant product was found to contain one mole-

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cule of lime combined with one molecule of silica. There is also some water held in chemical combination, but this seems to vary somewhat with the method of preparation. The silicate is attacked very readily by carbon dioxide, but this action resulted in an increase in the strength of the specimens treated.

Introduction of Carbon Dioxide During the Steam Treatment of Sand-Lime Brick.

In view of the effect of carbon dioxide on calcium metasilicate, it was thought possible to improve the strength of sand-lime brick by introducing carbon dioxide into the cylinder where the bricks are cured with steam. This process was patented, but is not now in use. There seems to be no doubt as to the results obtainable, the question being largely one of overcoming mechanical and economic difficulties.

Method for Estimating the Amount of Free Lime in the Presence of some Silicates and Aluminates.

When examining the calcium silicate found in sand-lime brick, mixtures of lime and silica were treated with steam. It was necessary to determine how much of the lime was left uncombined. The silicate is so readily decomposed that no ordinary method of analysis could be used. The method finally decided upon was to suspend the sample in a mixture of 2 parts of glycerin and 10 parts of alcohol, and titrate the lime with a solution of ammonium acetate in alcohol, using phenolphthalein as an indicator. The method was found to be accurate in the presence of all the compounds which might be present in sand-lime brick. It is accurate in the presence of tricalcium aluminate if especial precautions are taken to eliminate all water. It is not available in the presence of tricalcium silicate.

Information About Lime and Sand-Lime Brick.

The questions asked the Bureau by manufacturers of lime deal mainly with plasticity or with plant equipment. One man wants to know whether his lime is more plastic than another's. One wants to know how to improve the plasticity of his hydrate. Information is desired as to the type of kiln which can be used for burning lime when oil or coke is used for fuel. Consumers desire information mainly in regard to the kind of lime which should be used for a given purpose and where such lime can be obtained. The Bureau is frequently called upon to examine samples of limestone and report on it to prospective purchasers of quarries. Miscellaneous inquiries include the cause of hard lumps or of colored matter in the lime and the availability of oyster shells, marl, or coral as a source of lime.

The National Lime Manufacturers' Association recently established the Hydrated Lime Bureau for the purpose of advancing the interests of hydrated lime. All of their advertising literature is submitted to the Bureau of Standards before publication, in order that no statements will go out to the public which can not be substantiated.

Requests for information relative to sand-lime brick are general in their nature, as, "What is sand-lime brick, and is it safe to use it?" To answer such questions a circular describing the process of manufacture and properties of the material is now in course of preparation.

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It is desirable wherever possible to have first-hand information about the condition of the industry and that the manufacturers, dealers, and consumers become personally acquainted with the work of the Bureau. In line with this policy, all of the lime plants now operating in Washington and Oregon were visited. Especial attention was paid to the equipment of the plants, their efficiency and capacity, the quality of lime produced, and the market conditions. It is hoped that the acquaintances formed with manufacturers, dealers, and consumers will result in mutual advantage to them and to the Bureau and that they will feel more inclined to place their problems before the Bureau for solution. Thus the Bureau will be better able to understand their difficulties.

Temperature of Decomposition of Gypsum.

Plaster of Paris, or "hard wall plaster," is an important article in the building trades. It is obtained by the calcination of gypsum. There are, however, other products which can be formed by calcination, and the one which is produced depends mainly on the temperature used. Since these products differ materially in their physical properties, the temperature of calcination is an important commercial factor. A sample of pure gypsum was heated to constant weight at different temperatures, and the material produced was examined. At 110° to 120° C. it lost three-fourths of its water, the product being plaster of Paris. At 140° to 150° C. it lost the rest of the water. The material left was "soluble anhydrite." When mixed with water this material sets as quickly as plaster of Paris and produces a much stronger specimen. If the dry material is exposed to the air, it will quickly absorb water and revert back to plaster of Paris. At about 350° C. soluble anhydrite changes to ordinary anhydrite without any loss of weight. This anhydrite is practically inert to water and will not set in any reasonable length of time.

Effect of Compression in Baling of Raw Cotton.

An investigation has been commenced to determine the effect of compressing raw cotton to densities up to 50 pounds per cubic foot. At the present time American cotton is compressed to densities from 20 to 30 pounds per cubic foot, while cotton put up in Egypt and India is packed to a density of about 40 pounds per cubic foot. If cotton can be compressed at high densities without injury to the fiber, much smaller bales would result. The smaller bales would thus make handling less difficult, reduce the cost of transportation, lessen the cost of covering the cotton, and great saving would result to the railroads, steamship lines, and warehouses. This investigation was urgently requested by the General Managers Cotton Association of the Southeast, and it is hoped that facts will soon be obtained. The results of such an investigation should be very helpful to all that handle raw cotton.

Manufacture of American-Grown Flax.

An investigation was made of linen yarns and fabrics manufactured from domestic flax. Practically all the linen consumed in the United States is imported. One concern situated in the Middle West has attempted to grow flax and manufacture linen materials upon

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a commercial scale and to compete with the foreign goods. The Bureau has obtained samples of the domestic product and compared them with similar imported materials. Comparison of the results of physical tests of yarns, household linen, and dress goods showed that the quality of the domestic material was equal to that of the imported.

The results have considerable significance in that under proper supervision flax can be grown in this country to produce fiber which could be utilized in the manufacture of many linens now imported.

Identification of Textile Fibers.

An important investigation has been planned and some work done to determine methods of fiber analysis which will unmistakably identify certain fibers. This investigation will require a careful study, as all the properties of the various fibers used in textile fabrics will probably need to be examined. This study is of growing importance on account of the many new processes to which fibers are now subjected.

Automobile-Tire Fabric Investigations.

The cotton mills manufacturing automobile-tire fabric and the dealers in this cloth have in many instances developed their own methods of tests. The Bureau was urgently requested to develop and to standardize methods for testing this material. In cooperation with several mills the Bureau developed a method for determining tensile strength. This method has been adopted at least for one year by the textile committee of the American Society for Testing Materials. Several members of the society are some of the largest users of tire fabric. Many hundreds of tests have also been made to determine better methods for selecting tensile strength test specimens and for the determination of weight, threads per inch, elongation of fabric, moisture, crimp or yarns, etc. An extensive investigation upon the comparison of various tire fabric tensile-strength testing machines was made during the year. The results were of value in that they showed the inaccuracy of machines in use. One machine was found to record consistently incorrect readings of about 40 pounds, the tests being made upon fabric giving breaking stresses of about 220 pounds.

Adulteration of Textile Materials.

An important field of research is that of ascertaining the extent to which textile materials are adulterated and misrepresented. The public is becoming more and more concerned and often demands a guarantee that the goods purchased are as represented. Many tests by the Bureau during the past year conclusively illustrates the need of an extended investigation. The present work will be continued during the next fiscal year and, if possible, the variety of goods analyzed will be greatly enlarged.

Moisture in Cotton Fiber.

In response to several requests a preliminary investigation was made upon the rate and quantity of moisture cotton fiber would absorb or give up under various atmospheric conditions. A special

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instrument was devised and constructed in order to make accurate determinations. The preliminary results indicate that much valuable information should be obtained by the use of this instrument. The work has only recently been undertaken, but will be continued during the coming year. The results of this investigation will contribute toward a better knowledge of the important action of moisture upon textile materials relative to its weigh.

Physical Properties of Spool Thread.

A large number of tests were made upon common spool threads extensively used in the household and by garment manufacturers. Spool threads ranging in size from No. 12 to No. 70 were tested for tensile strength and number. One spool marked "No. 36 and 12,000 yards per spool" actually tested No. 28 and 11,500 yards of thread. It is hoped that an extended investigation upon this subject can be made the coming year.

Tensile Strength and Weight of Fabric as Influenced by its Moisture Content.

The effect of moisture upon the strength and weight of textile fabric has been known in a general way for many years. It is only recently, however, that American manufacturers, buyers, and sellers have realized that they should become definitely acquainted with the moisture content of the fabric they are handling. For instance, automobile-tire fabric (cotton) breaking at 240 pounds, with 3.5 per cent moisture content, will have a tensile strength of 320 pounds, with 8.5 per cent moisture present. Under these conditions of moisture there will be a difference in weight of about 1 ounce per square yard.

Wool fabric is influenced, by the presence of moisture, in the same direction to that of cotton as regards weight, but in the opposite direction relative to tensile strength. In other words, wool fabric will become heavier with additions of moisture but its tensile strength will be less. In view of its importance, future work will cover a wide scope of testing and research.

Worsted Yarn of Commerce.

Wool-yarn manufacturers have requested the Bureau to make a study of the oil and moisture content of the more common worsted yarns. Considerable data have now been compiled, but a much greater variety of yarns will be studied the coming year. Other physical properties, such as tensile strength, correctness of yarn number, and effect of atmospheric moisture will be investigated.

Comparative Tests of Cotton and Wool Flag Bunting.

For many years wool fiber has been employed in the manufacture of bunting in the higher priced flags. During the past year cotton bunting and cotton flags were manufactured at about one-half the price of the wool bunting. A series of comparative tests were made upon several brands of wool bunting and cotton bunting. The tests included tensile strength, weight, fastness of color, and exposure to weather conditions. The cotton bunting was superior to the wool bunting in many respects; therefore cotton is being used rather extensively for many purposes.

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The results of tests were furnished to all Government departments, and the Bureau is informed that a considerable saving in many offices has resulted from the use of cotton flags as a substitute for wool.

Scouring of Domestic Wools.

Assistance was given the Division of Animal Husbandry, Department of Agriculture, concerning the shrinkage of certain wool fleeces. These fleeces were carefully grown under the supervision of Government experts with the view to an investigation of the yield of clean wool and a study of the character of the staple. The Bureau scoured 35 fleeces and reported the yield of clean wool. The investigation was done in connection with range breeding experiments that will be continued for some years.

Determination of the Length of Textile Yarns of Commerce.

Considerable study has been made upon methods of accurately determining any length of yarn which has been wound in skeins or upon bobbins, cops, spools, etc. A new apparatus was designed and constructed by the Bureau, and the results of tests thus far indicate that the instrument will be satisfactory. The first importance of this instrument is in determining an accurate length, then by ascertaining the weight of a certain length the size or yarn number can be calculated. The knowledge of the yarn number is of the greatest importance in the manufacture of yarns and fabrics, to the consumer, and in the application of the duty to imported yarns. Under the terms of the last tariff law all imported yarns are taxed at varying rates according to their yarn number. The Bureau has furnished the Customs Service considerable information in designing apparatus and developing better and more economical methods for textile analysis at the various ports. Further researches will be conducted, and it is believed that a method will be developed by which many of the controversies arising in the trade can be readily and satisfactorily settled.

Methods of Testing Twine.

A very important field of work is the drafting of specifications and the testing of twine.

Several of the Government departments combined use more than $300,000 worth of twine a year. The Bureau drafts the specifications for many of these departments, and tests are made upon the deliveries to ascertain if they comply with the requirements. Two thousand and twenty-five balls of twine were tested during the year.

The Post Office Department purchases twine specifying a certain yardage and tensile strength at a definite weight. The Bureau tests the samples under the specified conditions, and it thus enables the price to be satisfactorily adjusted.

Textile Tests.

The materials submitted for examination and the number of samples tested by the Bureau as routine work numbered 3,444, classified as follows: Common twine, 2,023; imported yarn, 860; thread, cord, cable, and rope, 61; denims, tire fabric, bags, sheeting, canvas, blankets, uniform cloth, tracing cloth, coin sacks, flag bunting, book cloth, dress goods, cement bag fabric, shirting, gingham, etc., 500.

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More than 300 additional samples were tested in cooperation with mills who assisted the Bureau in some of its investigations. These were not considered as ordinary routine tests.

The samples of material designated above do not properly illustrate the work involved, as the actual number of routine tests were more than 33,000. Samples were submitted by Government establishments and others, and the following number of tests were made: Post Office, 16,752; Customs Service, 8,600; Interior, 3,084; Treasury, 464; Agriculture, 430; Commerce, 130; Panama Canal, 106; War, 150; Mississippi River Commission, 240; private parties, 3,240.

The number of tests increased 33 per cent over the previous year—that is, more than 10,000 tests.

Information Furnished on Textile Subjects.

Many inquiries were received from automobile-tire manufacturers and mills making tire fabric desiring information concerning the testing of the cloth. Several mills sent the Bureau numerous data covering many months of tests, and in return the Bureau rendered assistance in suggesting better methods of compiling these data, methods of tests, and necessary laboratory apparatus and its calibration. The results of the Bureau's investigations were also furnished the mills. The Bureau's activities have led to the adoption by the members of the textile committee of the American Society for Testing Materials of tentative methods for testing and specifications for automobile-tire fabric.

There have been numerous requests by testing laboratories regarding tensile-strength apparatus to install for various textile tests.

From the general public many inquiries were received as to simple methods for determining adulterations, the effect of cotton mixed with wool, employment of artificial silk as a substitute for natural silk, jute as a substitute for flax, hemp, and wool, etc.

From cotton mills information was often requested upon the influence of moisture in the atmosphere when the fiber was passing through certain processes and that of the resultant moisture in the finished product.

The various Government departments were rendered assistance in the drafting of specifications for textile purchases and testing of the deliveries. The latter work was instrumental in the rejection of many deliveries which did not comply with specifications. The work also facilitated the economic purchase of textile supplies. Much cotton bunting and flags are now being used instead of wool, as the Bureau has found that the cheaper cotton material, in many instances, can be economically employed.

The Bureau has assisted manufacturers of special textile apparatus in suggesting improvements on their present machines and desirable new devices needed by the textile industry. It has also constructed machines for the accurate determination of length of textile yarns and the "crimp" of yarns that have been woven into a fabric.

Considerable assistance was given the Customs Service in the proper appraisement of duties upon textile yarns.

Several months of work were devoted in scouring raw wool fleeces for the Agricultural Department. The results of the investigation were valuable to that office in their sheep-breeding experiments.

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Special information was given in regard to linen produced from domestic flax.

Publications on Textile Subjects.

The Bureau has recently published a revised edition of Circular No. 41, on "Testing and Properties of Textile Materials." The previous edition of the circular was issued two years ago. It deals in a general way with textile analyses, with particular attention given to methods of test; atmospheric conditions under which certain tests should be performed; precautions to be exercised; results of special tests; adulterated textile materials; rates of charges, etc. Nearly 2,000 copies of the previous issue have been furnished on request to interested parties, and it has been especially in demand during the past year.

Textile schools, manufacturers, buyers and sellers, mill workers, etc., use this circular as a guide in their testing, and it serves in a large way to educate the textile trade along lines of more scientific manufacturing, buying, and selling. This is becoming more and more important for the reason that the large consumers buy upon definite specifications and test all deliveries.

An investigation has been made upon certain characteristics of common cotton yarns with special reference to tensile strength and yarn number under different atmospheric conditions. The results of the investigation have been printed and distributed to the textile trade as Technologic Paper No. 19, "The Physical Properties of Cotton Yarns."

Technologic Paper No. 57, entitled "Difference Between Weight of Raw and Clean Wools," is now ready for distribution. The paper deals with the yield of clean wool obtained after scouring. Tests were made upon 49 fleeces of typical Australian and New Zealand wools commonly imported into this country. The investigation was made to ascertain the shrinkage variation in two samplings of the same fleece and the difference in shrinkage between two fleeces of the same breed of sheep. The results are given in detail and should be of value to wool manufacturers and wool buyers.

The Bureau will forward these papers upon request and will also furnish any other textile information that can be supplied.

Investigation of Paper for Permanent Records.

The statement is often made that for durability no paper made under modern methods can compare with that made 100 or 200 years ago. Undoubtedly many of the modern papers would have a relatively short life as compared with those papers made before the introduction of some of the wood pulps and before the use of chemical bleaching became necessary to satisfy the demand of the public for bright white papers.

The question of the upkeep of modern libraries is a serious one, and at the request of a number of libraries this Bureau is investigating the conditions that cause paper to turn yellow and become brittle. At the present time there are no reliable tests which can furnish information in regard to the possible life of a paper in actual use. The object of this investigation is to develop such tests, in order that permanent papers may be used when needed.

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Influence of Atmospheric Moisture on Printing Paper.

Paper used for general printing and for printing by means of the various color processes, such as lithography, etc., are subject to expansion and contraction, due to changes in the amount of moisture in the air. This change in size, if excessive, may cause a serious loss to the printer, due to the spoiling of partly finished work. At the suggestion of a number of lithographers and printers this question has been taken up for the purpose of devising means to overcome this difficulty. There appears to be a point above which a change in the relative humidity (per cent moisture content of the air) will cause a greater change in the dimensions of a sheet of paper than is found to be the case for similar changes in relative humidity below that point. Certain manufacturing conditions tend to increase the effect of atmospheric moisture on the change in size of paper.

It is proposed to study the manufacturing conditions involved, in order to determine means whereby the effects caused by change of humidity may be overcome.

Comparison of Various Types of Paper-Testing Devices.

The necessity for standard methods of testing materials has spread to the paper industry, and a demand has been created for testing devices the results of which may be interpreted in terms of the quality of a paper when used for a particular purpose. With this in view, the Bureau is now carrying out a series of tests on a number of types of testing devices commonly used in the paper industry.

Utilization of Old Papers for Remanufacture into Paper.

One of the most available materials has been very largely overlooked in the demand for a new raw material for the manufacture of paper. Only a small percentage of all paper made is collected for remanufacture. The methods for the recovery of this possible raw material are very wasteful, adding to the cost of the finished product.

It is proposed to study the present methods employed in the recovery of old papers, with the object of determining the most suitable method.

Casein and its Application to the Paper Industry.

Casein is an important substance found in milks. It may be used as an adhesive and as such is very largely used in the paper industry to bind a thin film of clay or other material to the surface of the paper. Paper so treated is known as coated paper, and is used in the reproduction of photographs where detail is essential and for printing by means of the various color processes, such as lithography, etc.

Casein is produced from either skim milk or from buttermilk. Commercial skim milk caseins are superior to buttermilk caseins, due to the fact that they contain less insoluble material, greater adhesive properties, and their use requires a less complicated method. The best caseins are imported, and for this reason any investigation tending to improve the domestic product will help to make an American industry less dependent on foreign made goods.

This casein investigation was undertaken at the request of the Dairy Division, Bureau of Animal Industry, Department of Agriculture, and is a cooperative investigation. The Dairy Division has

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installed the necessary apparatus for the manufacture of casein, and the Bureau of Standards has undertaken the study of its application to the paper. Most of the necessary machinery for coating paper has been installed in the paper laboratory, and much of the preliminary work has already been done.

The particular purpose of the investigation is to establish the most suitable methods for the production of skim milk and buttermilk caseins, in order to overcome the great variation in quality found in commercial lots. Attention will be given to methods of testing the finished product and also the best methods for its use in the paper industry.

Paper Testing.

During the past year the Bureau has tested the following samples of paper: For the Government Printing Office and the Government departments, 3,909 samples; for public and private interests, 157 samples; total number of samples tested, 4,066. The large amount of routine testing is an increase of 36.6 per cent over that done last year and has very seriously handicapped the paper laboratory in carrying out the investigations that have been demanded.

Information Furnished on Paper.

This section has been called upon by the several departments to render special service in connection with the preparation of their paper specifications, and assistance to departmental committees on awards of contracts of this kind has been given to the congressional Joint Commmittee on Printing, General Supply Committee, Post Office Department Supply Committee, Committee on Awards for Government Envelopes, Committee on United States Currency Paper Awards, and a number of other committees.

The range of inquiries has covered not anly the methods and processes used in the pulp and paper industry and the testing of papers but also many inquiries from allied industries. In a number of cases manufacturers have submitted samples of imported papers, with the request that a report be made as to how such papers could be duplicated. Special attention is always given to an inquiry wherein assistance may be rendered to an American industry.

The following is a list of a few of the inquiries received and give an illustration of the range of subjects covered by means of letters and reports:

Report to State of Connecticut as to a suitable paper for their court publications for permanent use.

Reports on the possibility of using certain waste grasses for paper making, it being shown that none of the common grasses are suitable, due to low yield of material, and the cost of manufacture. Such material can only be used when other products of value besides paper pulp are secured.

Requests for standard paper samples and specifications and lists of testing devices and the method of operating the same.

Request for samples of various paper-making fibers and pulps and lists of manufacturers of various pulps and papers.

Suitability of various sizing materials.

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Suitability of waste cotton lint from cotton seed for manufacture into paper pulp and guncotton.

The manufacture of vegetable parchment paper and reason why the imported article is of superior quality to that of domestic manufacture.

Details as to the manufacture and use of the following papers: Cigarette paper; dialyzing paper; chemical filter paper; photographic paper; lining paper for electric dry batteries; decalcomania paper, etc.; stereotype matrix paper; lithograph paper; offset paper, etc.

The Bureau has been visited by a great many representatives of the paper trade and has succeeded in establishing cordial relations that will greatly enhance its cooperative work in the paper industry.

Investigation of Lubricating Oils.

As a result of trouble that has been experienced from the emulsification of engine oils in service, the Post Office Department has requested this Bureau to investigate the subject with the view of developing an adequate test for emulsibility. This investigation is well under way, and the apparatus that has been designed for carrying out the work is giving very satisfactory results. A test for emulsibility has been developed, and it has proved of so much value as an aid in selecting the most suitable oil from samples submitted by prospective contractors that it has been added to the list of routine tests to which oils received from Government departments are submitted. In its present form the test does not apply to steam-engine cylinder oils. This test has been communicated to the American Society for Testing Materials for the information of the committee on standard tests for lubricants.

The conversion tables for intercomparison of different measures of viscosity, which were mentioned in the last annual report, have been presented to the American Society for Testing Materials, and will be published in their proceedings as the work of this Bureau.

A publication is in course of preparation in which the theory of viscous flow, upon which the action of viscosimeters depends, will be considered in detail.

Investigation in Connection with Government Power Plants as to Quality of Lubricating Oils.

During the past year the Bureau has employed an oil engineer whose duties are to investigate all complaints of poor service of oils delivered under Governmental contracts in Washington, to ascertain the reasons for unsatisfactory service, and to suggest remedial measures. Numerous visits have been made to Government power plants upon request, and in this way the Bureau has been able to render valuable assistance of a distinctly practical nature.

A large number of oils have been tested, and the General Supply Committee has been advised in regard to revising the forms of contract for the purchase of lubricating oils for Government departments. Specific recommendations have been made, in cooperation with the chemical department, in regard to the comparative value of oils submitted by contractors.

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Properties of Rubber.

An investigation of the physical properties of rubber, with special attention to the influence of temperature on these properties, has shown satisfactory progress during the past year. The results of this work appear in the third edition of Circular No. 38, "The Testing of Mechanical Rubber Goods." Practically all of the testing machines and apparatus used in this work have been developed at the Bureau. The Bureau's equipment, which includes a mixing and vulcanizing plant and a testing room with automatic temperature regulation, offers exceptional facilities for research work. A rubber-tubing machine has been installed and is now being used for the production of experimental tubing of various compositions. The object is to develop specifications for laboratory tubing which will insure more satisfactory service than has been obtained in the past. During the past year 34 rubber compounds have been made. About one-half of these have been made into tubing which is being given a service test under varying conditions in the different laboratories of the Bureau. A number of samples of special composition have been prepared and are being used in checking different methods of chemical analysis.

The Bureau has cooperated with manufacturers and technical societies in developing specifications for and methods of testing rubber.

The special apparatus and testing machines designed at the Bureau have been of distinct benefit to the rubber industry and to large purchasers of rubber goods.

Investigation of Rubber Hose.

Specifications for rubber hose often require that the tube or lining be made from calendered sheet. As distinguished from handmade tubes of this kind, tubes are sometimes made by machinery, the process being known as "squirting."

During the past year the Bureau has conducted experiments with the view of developing a test that may be depended upon to identify tubing as "calendered" or "squirted." The investigation has not been completed, but from the results thus far obtained it appears that the elasticity of rubber that has passed through a tubing machine is practically the same in all directions, whereas it is generally known that calendered sheet is more elastic in the transverse than in the longitudinal direction. It is thought that a test for elasticity will prove to be the most satisfactory method of distinguishing between handmade and machine-made tubes in cases where tubes can not be identified by inspection.

Kapok Fiber for Life Preservers.

At the request of the Steamboat-Inspection Service, this Bureau has investigated the value of kapok fiber as a buoyant material for life preservers, and a report based upon the results of chemical, microscopical, and physical tests has been made.

It was found that the buoyant qualities of kapok fiber are not the same for all products of similar trees, and since the difference is purely physical it was recommended that the final valuation of kapok should be on a physical basis. The best test of a life preserver is

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a buoyancy test, extending over a definite time, during which time the preserver should be totally submerged at intervals.

Efficiency of Hack-Saw Blades.

Very little progress was made during the past year in the investigation to determine the relative efficiency of hack-saw blades, taken up at the request of the General Supply Committee. The data thus far obtained show that the specifications in general use can not be relied upon to secure blades of good wearing quality and high efficiency. The Bureau's work has shown that in order to compare the results obtained in different laboratories it is not only necessary that the metal used for testing the blades be the same, but that in each case the blades be tested under the same conditions as regards cutting speed, pressure on blade, and length of stroke. The work of this investigation will be continued and pushed as rapidly as circumstances will permit.

Investigation and Tests of Shot Lines for the United States Coast Guard.

Tests of unusual importance have been made in connection with the purchase of flax shot lines for the Coast Guard. The service required of shot lines is of such a nature that it is necessary to exercise the greatest care in selecting the material used in their manufacture and to subject the lines to careful inspection and test. During the past year 160 samples (representing 51,300 yards) of shot lines have been tested, one-half of which was rejected for failure to meet the specified requirements of tensile strength.

Test of Fire Hose for Use in the District of Columbia.

At the request of the District Commissioners, the Bureau has on several occasions during the past year tested 50-foot lengths of fire hose submitted by various manufacturers under competitive bid for acceptance by the District of Columbia Fire Department.

These tests have resulted in a saving of about 50 per cent in the cost of hose without sacrificing anything in quality or efficiency.

Tests of Miscellaneous Materials.

Miscellaneous tests which were made principally for Government departments included 158 samples of rubber hose, 115 samples of packing (rubber, asbestos, etc.), 209 samples of rubber-covered wire, 35 samples of rubber bands, 246 samples of rope, 94 samples of leather belting, 37 samples of hack-saw blades, and smaller numbers of various other materials, amounting to 1,057 samples in all.

III. OFFICE, AND ENGINEERING AND CONSTRUCTION.

1. OFFICE.

Publications.

During the fiscal year just ended the Bureau issued 137 publications, of which 46 were new and the remainder revised editions and reprints. The new publications included five numbers of the Bulletin of the Bureau of Standards, which completes the eleventh volume of the scientific papers. There were also issued 25 scientific papers, 10 new technologic papers, 8 new circulars, and 3 miscellaneous publications.

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The following new circulars were issued during the year: "Units of weight and measure, definitions and tables of equivalents," "Standard methods of gas testing," "Safety rules to be observed in the operation and maintenance of electrical equipment and lines," "National standard hose couplings and fittings for public fire service," "Measurement of time and tests of timepieces," "Regulation of electrotyping solutions," "Composition, properties, and testing of printing inks," and "Proposed national electrical safety code."

The following scientific papers were issued: "Testing of potentiometers," "Emissivity of metals and oxides—I, Nickel oxide (NiO) in the range 600° to 1,300° C.," "Adjustments of the Thomson bridge in the measurement of very low resistances," "Quantitative experiments in radiotelegraphic transmission," "Measurements on standards of radiation in absolute value," "Experimental study of the Koepsel permeameter," "Various modifications of bismuth-silver thermopiles having a continuous absorbing surface," "Combustion calorimeter and heats of combustion of cane sugar, benzoic acid, and naphthalene," "Specific heat of copper in the interval 0° to 50° C. with a note on vacuum-jacketed calorimeters," "Equilibrium in the system: lead acetate, lead oxide, and water at 25°," "Watthour meter method of testing instrument transformers," "Insulating properties of solid dielectrics," "Direct-reading instrument for measuring the logarithmic decrement and wave length of electromagnetic waves," "Electrical resistance and critical ranges of pure iron," "Absorption, reflection, and dispersion constants of quartz," "Characteristic equations of tungsten filament lamps and their application in heterochromatic photometry," "Vibration electrometer," "Studies on the silver voltameter," "Wheatstone bridge for resistance thermometry," "Emissivity of metals and oxides—II, Measurements with the micropyrometer," "Emissivity of metals and oxides—III, Total emissivity of platinum and the relation between total emissivity and resistivity," "Comparison of stellar radiometers and radiometric measurements on 110 stars," "Temperature coefficient of magnetic permeability within the working range," "Methods of measuring the inductances of low-resistance standards," and "Emissivity of metals and oxides—IV, Iron oxide."

The following technologic papers were issued: "Industrial gas calorimetry," "Iodine number of linseed and petroleum oils," "Observations on finishing temperatures and properties of rails," "Analysis of printing inks," "Veritas firing rings," "Lead acetate test for hydrogen sulphide in gas," "Standardization of No. 200 cement sieves," "Hydration of portland cement," "Study of the Atterberg plasticity method," and "Study of some recent methods for the determination of total sulphur in rubber."

The following miscellaneous publications were issued: "Annual report of the Director for the fiscal year ended June 30, 1914," "Ninth annual conference on the weights and measures of the United States," and "Decennial index to the Bulletin of the Bureau of Standards."

Technical Library.

The Library contains 12,800 accessioned volumes, almost all of a scientific and technical character, being an increase of 1,125 for the fiscal year; and 362 periodicals are currently received, 211 in English and 151 in other languages.

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Personnel.

During the year the Bureau staff comprised 233 statutory appointees, and about 150 engaged in researches and investigations specially authorized by Congress. The statutory positions included 145 scientific positions, 32 office assistants, 34 engaged in the operation of the plant, and 22 in the construction. There were 323 personnel changes during the year. These included 65 separations from the Bureau, of which 34 were resignations.

Correspondence.

The Bureau's correspondence is mainly technical and scientific in character and requires the attention of experts and special care in the preparation of replies. The problem of indexes and files is necessarily complex in view of the wide range of technical subjects covered by the Bureau's functions. The number of letters handled by the file room during the fiscal year was 65,000, an increase of about 20 per cent compared with the previous year. In view of lack of space and help the system of indexes and files was reduced to a minimum several years ago. Experience has shown that undue simplicity as recommended by some filing experts may easily reduce the efficiency in view of Government requirements. It is felt that the growth of the correspondence requires that the system be revised and a more complete cross-reference and charging system be installed. This is now under consideration and will be arranged as soon as possible.

Storeroom.

The purchase and distribution of equipment and supplies is handled through the storeroom. This includes system for orders, inventory, charging out, and stock catalogue and maintenance of standard supplies. The inventory record covers more than 60,000 pieces of equipment, largely scientific apparatus of the most varied kinds. It has become necessary that a high-grade clerk be provided as a property clerk.

Appropriation Statements.

The following statement shows the amount and object of each appropriation provided for the Bureau for the fiscal year 1915, the disbursement during the year, the amount of unfilled and unpaid orders at the close of the year, and the unexpended balance remaining at the close of business June 30, 1915:

Appropriation.	Total appropriation.	Disbursement.	Liability.	Balance.
Salaries	$293,500.00	$266,412.79	$12,020.37	$15,066.84
Equipment	[a] 57,311.33	38,184.85	19,091.96	34.52
Repairs and alterations	2,000.00	1,524.02	474.50	1.48
General expenses	27,000.00	21,584.35	5,320.39	95.26
Grounds	6,000.00	5,001.67	997.07	1.26
Testing structural materials	100,000.00	85,940.45	13,970.47	89.08
Testing machines	30,000.00	28,313.20	1,647.45	39.35
High potentials	15,000.00	13,229.81	1,766.75	3.44
Refrigeration constants	15,000.00	13,996.45	995.03	8.52
Testing railroad scales	40,000.00	17,629.54	22,370.46	.....
Fire-resisting properties	25,000.00	15,068.85	9,308.51	22.64
Testing miscellaneous materials	20,000.00	18,704.61	1,217.96	77.43
Railway materials	15,000.00	10,442.95	4,548.49	8.56
Public utility standards	25,000.00	16,528.01	8,317.16	154.83
Chemical laboratory	25,000.00	2,375.00	3,532.30	19,092.70
Total	695,811.33	555,536.55	105,578.87	34,695.91

[a] Includes reimbursement of $7,311.33.

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The following statement shows the condition of the appropriations for the two preceding fiscal years at the close of business June 30, 1915:

FISCAL YEAR 1913.

Appropriation.	Total appropriation.	Disbursement.	Liability.	Balance.
Salaries	$241,312.66	$226,682.95	.....	$14,629.71
Equipment	50,000.00	49,054.36	$619.20	326.44
Repairs and alterations	2,000.00	1,980.80	.....	19.20
General expenses	25,000.00	24,544.05	174.18	281.77
Grounds	3,000.00	2,986.81	.....	13.19
Testing structural materials	[a] 77,342.50	77,045.29	47.99	249.22
Testing machines	30,000.00	29,841.13	.....	158.87
Investigating effects of electric currents	10,000.00	9,921.03	4.50	74.47
Refrigeration constants	15,000.00	14,915.58	45.10	39.32
Additional land	85,000.00	68,034.00	.....	16,966.00
Tank	5,000.00	4,996.98	.....	3.02
Total	543,655.16	510,002.98	890.97	32,761.21

FISCAL YEAR 1914.

Salaries	$290,940.00	$270,123.88	.....	$20,816.12
Equipment	[b] 59,075.00	58,417.49	$540.18	117.33
Repairs and alterations	2,000.00	2,000.00	.....	.....
General expenses	27,000.00	25,365.14	467.13	1,167.73
Grounds	3,000.00	2,997.53	.....	2.47
Testing structural materials	75,000.00	74,609.04	136.89	254.07
Testing machines	30,000.00	29,924.67	42.66	32.67
High potentials	15,000.00	14,963.71	4.10	32.19
Refrigeration constants	15,000.00	14,601.61	348.48	49.91
Testing railroad scales	25,000.00	22,315.06	2,684.94	.....
Fire-resisting properties	25,000.00	23,324.49	856.04	819.47
Equipment, electrical laboratory	25,000.00	24,960.66	22.30	17.04
Workshop and storehouse	45,000.00	44,536.23	423.78	40.00
Total	637,015.00	608,139.50	5,526.50	23,349.00

[a] Includes reimbursement of $2,342.50.
[b] Includes reimbursement of $9,075.

Statement of Tests.

The work of the Bureau involves, among other things, a large amount of testing of standards, measuring instruments, and materials. It involves primarily the investigation of the scientific principles underlying the tests, the study of existing methods, and the development of new standard tests of determinate accuracy. For each test a reasonable fee is charged, except when made for the National or State Governments.

During the fiscal year 1915 the Bureau made 116,204 tests and inspected 1,861,439 incandescent lamps at various factories for other departments of the Government. Of the total tests, 105,992 were for the Government and 10,212 for the public. The testing was distributed as follows, according to nature of tests: Length measures, 949; mass, 7,529; capacity, 2,230; temperature, 15,734; hydrometry, 2,224; miscellaneous, 153; optical, 1,500; time, 28; electrical, 1,223; photometry, 3,506; chemical, 11,471; engineering (miscellaneous), 878; engineering (instruments), 367; structural materials, 60,989; paper and textiles, 7,359; metallurgical, 64. The estimated fees amount to $154,733.59, of which $14,438.43 was collected on account of tests for the public. The fees noted for Government tests are included merely for comparison purposes, as no charge is made for tests performed for the National or State Governments.

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NUMBER AND VALUE OF TESTS COMPLETED, FISCAL YEAR ENDED JUNE 30, 1915.

Nature of test.	For Government.		For public.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.
Length	636	$1,025.30	313	$830.50	949	$1,855.80
Mass	6,252	3,293.45	1,277	657.65	7,529	3,951.10
Capacity	1,803	530.15	427	331.35	2,230	861.50
Optical	1,443	1,709.70	57	92.50	1,500	1,802.20
Hydrometry	2,066	2,081.50	158	273.00	2,224	2,354.50
Miscellaneous	144	190.40	9	13.80	153	204.20
Time	.....	.....	28	120.00	28	120.00
Temperature	9,843	3,588.39	5,891	2,979.04	15,734	6,567.43
Electrical	770	2,675.00	453	2,988.00	1,223	5,663.00
Photometry [a]	3,330	11,483.55	176	629.30	3,506	12,112.85
Chemical [b]	10,856	66,878.10	615	3,164.40	11,471	70,042.50
Physical and mechanical tests:						
Engineering, miscellaneous	878	2,520.50	.....	.....	878	2,520.50
Engineering instruments	314	1,589.00	53	229.50	367	1,818.50
Structural materials [c]	60,634	32,531.67	355	1,374.00	60,989	33,905.67
Paper and textiles	6,982	9,741.45	377	598.51	7,359	10,339.96
Metallurgical	41	457.00	23	156.88	64	613.88
Total	105,992	140,295.16	10,212	14,438.43	116,204	154,733.59

[a] In addition, the Bureau inspected 1,861,439 incandescent lamps at various factories for other departments of the Government, the fees for which would amount to $5,546.47 additional.
[b] Of these tests, 5,513, amounting to $39,941.80, were chemical tests made on structural materials.
[c] These figures include the inspection of approximately 53,708 samples of Portland cement.

2. ENGINEERING AND CONSTRUCTION.

Mechanical Plant.

The completion of the chemical laboratory authorized by Congress will necessitate enlargement and remodeling of the power and heating system by the construction of an addition to the present building, or a smaller one detached from it, to provide for additional boiler and power-plant space. The Bureau has also outgrown the capacity of its refrigerating plant originally installed at the establishment of the Bureau. The necessity for the control of temperature and humidity in many tests and experimental problems requires the installation of a larger plant at the earliest possible moment. The general condition of the power plant is far too inadequate.

Construction Facilities.

The care of the mechanical plant, of the buildings, and especially the construction of special apparatus of all kinds, necessitates a corps of mechanics skilled in the various kinds of construction. Every investigation requires the construction of more or less special apparatus involving mechanics skilled in the construction of all kinds of precision instruments. These services include plumbing and steam fitting, electrical wiring, woodworking, instrument making, glass blowing, and glass grinding—all are involved in both investigational and testing work. In fact the Bureau's efficiency depends very largely upon having services of this sort available.

Care of Buildings and Grounds.

The care of the buildings of the Bureau has been inadequate for several years. This has been in part remedied by a system of continuous supervision of the janitor service. It is hoped that the janitor service may be increased during the coming year.

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During the year some grading has been completed south of the main laboratory and around the east laboratory. Pierce Mill Road has been temporarily improved by eliminating bad curves and extreme grades. This has resulted in improved truck service. The care of the grounds has become of sufficient importance to warrant the continuous employment of a foreman.

IV. RECOMMENDATIONS.

Buildings.

Attention is again called to the necessity of properly housing the structural materials work, especially the branch of the work at Pittsburgh, and which is temporarily located in buildings of the War Department at the Arsenal grounds. These buildings are entirely unsuited for the purpose either as to location or character, and the Bureau has considered it unwise to expend any funds on their preparation as laboratories other than the barest necessities. Furthermore, the War Department has repeatedly asked for the vacation of the building.

Every effort is being made by the Bureau to place its structural work on a basis commensurate with its importance. Considerable heavy equipment has been accumulated both at Pittsburgh and Washington, and more will be needed. Good work is being carried on at both places but the large testing machines, furnaces, and other heavy equipment should be brought together in a building designed for the purpose and sufficiently large to accommodate all heavy equipment of this kind. It is uneconomical and inadvisable to proceed with the installation of permanent heavy equipment in temporary quarters.

Transverse Testing Machine.

Attention is again called to the necessity of adding to the Bureau's equipment a large transverse testing machine capable of testing the transverse strength of full-sized steel girders used in bridges and buildings; also brick, stone, and concrete arches, floor constructions, etc.

Since transmitting the original estimate for this machine, much additional evidence has been secured, all indicating the great need on the part of engineers for data that can only be obtained by a large machine of this character. It is therefore recommended that a sufficient sum be again included in the estimates to enable the Bureau of Standards to begin its design and construction.

Radio Laboratory.

Radio communication has recently become of extreme importance both in Government work and to the public. This method of communication is still largely in the experimental stages. Future progress and improvement in radio communication will be in direct proportion to the progress that is made in the knowledge of the underlying principles involved. Several departments of the Government are deeply interested in maintaining this method of communication on the best possible basis. It would not only be more economical, but productive of much more efficient work to concentrate the laboratory

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work of the Government at one place in a small laboratory especially designed for it. It has been agreed by all of the departments concerned, namely, War, Navy, Treasury, Post Office, Agriculture, and Commerce, that the location of the laboratory at the Bureau of Standards would prove of great benefit both as to the economical performance of the work and by its close proximity to the scientific work of the Bureau, especially that of the electrical division. An item of $50,000 for the construction of a suitable radio laboratory was included in the estimate for the current year, but was not appropriated for. It is recommended that it be again submitted in the estimate for the next fiscal year.

Salaries and Additional Assistance.

Moderate increases are submitted for the heads of divisions. These positions involve the responsible administration of the several lines of the Bureau's technical activities. The compensation is not adequate either in view of the duties involved, the order of ability required, or in comparison with similar grades elsewhere. These include the chief physicist, chief chemist, the physicists, secretary, and chief mechanician.

Several increases are also submitted for the skilled workers in the operative and construction staff, namely, the glassworker, the glass blower, and the skilled woodworker. An increase in these salaries is desirable, as their rate of pay is below the average standard for such services elsewhere. An estimate is also submitted for an increase for the assistant engineer, who is in direct charge of the engineering plant and the systems of heat, light, and ventilation connected therewith.

During the past two years the Bureau's work has grown far more rapidly than its resources. This is especially true in consultation and testing work for the Government. In several sections of the Bureau it has been necessary to suspend all investigations in order to care for the testing of materials purchased on Government contracts. This would not be so serious if suitable specifications and methods of testing were in existence for the wide range of materials to be tested; but it can truly be said that such is the case in only a very limited number of materials. It is felt that this situation can be remedied to a large extent by a reasonable increase in the minor assistants, such as apprentices, aids, and assistants up to and including the grade of $1,400. A few of these men in each section could almost double the Bureau's output of testing, and, what is still more important, allow more time on the part of advanced men for the improvement of methods and specifications.

Clerical Services.

The clerical assistance of the Bureau has been entirely inadequate for the past four years. So critical has this become during the past year that it is a serious question as to whether the Bureau is not very materially reducing the efficiency of all branches of its work by the lack of anything like adequate clerical assistance. This is especially true in the case of property records, accounting, files, and correspondence.

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Skilled and Unskilled Labor.

The situation of the Bureau is such that it is impractical to secure economical contracts for small jobs of construction. These are continually arising in all kinds of experimental work. Their nature is such that they require the supervision of the experts of the Bureau. It is no uncommon matter when soliciting bids for this class of work to receive them of three or four times the amount necessary. This is due to the distance of the Bureau from the city, the necessity for the supervision of the work on the part of the contractor, and his hesitation to undertake work of a character unfamiliar to him. It is therefore recommended that the Bureau staff of this class of skilled and unskilled laborers be increased.

Technical Investigations.

Items are included among the estimates for the fiscal year 1917 to cover several of the more urgent technical and scientific investigations which should be undertaken by the Bureau. There is the utmost need in the industries for accurate data concerning materials and energy, their measurement and properties. These subjects are a part of the authorized functions of the Bureau, but they have not yet been adequately provided for. These appropriations will enable the Bureau to render a direct service to the industries concerned. The investigations include color standards, clay products, standard materials, physical constants, standardization of mechanical appliances, and textiles, paper, leather, and rubber.

The economic value of these investigations will unquestionably repay many times the original outlay. That they are urgently demanded by the industries is evidenced by the continual receipt of letters calling for the data which these investigations alone can supply. Furthermore, the results will enable the Bureau to put the work of standardizing the measurements and quality of these materials upon a basis not heretofore practicable.

Promotion of Export Trade.

It is intended to use this appropriation to meet a new and urgent demand which has recently arisen from several industries for the certification of American products for export trade. In the trade-promotion work of this department it is found that a governmental certificate of the actual quality of export products is becoming more and more necessary. In many foreign countries the government testing laboratories are furnishing such certifications, and this gives the foreign manufacturer a distinct advantage over the manufacturer in this country, especially in cases where a quality certification by a recognized governmental agency is required by the specifications for the materials to be exported. This appropriation is designed to place the American exporter, so far as possible, on an equality in this respect with his foreign competitors.

The appropriation provides for the charge of an adequate fee for each certification to be made by the Bureau of Standards to reimburse for the expense incurred.

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The appropriation suggested will prove a great help to manufacturers and producers in this country who are desirous of selling their goods to foreign countries.

Respectfully,

S. W. STRATTON, *Director.*

To Hon. WILLIAM C. REDFIELD,
Secretary of Commerce.

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REPORT

OF THE

DIRECTOR OF THE CENSUS

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REPORT

OF THE

DIRECTOR OF THE CENSUS.

DEPARTMENT OF COMMERCE,
BUREAU OF THE CENSUS,
Washington, October 2, 1915.

SIR: There is submitted herewith the following report upon the operations of the Bureau of the Census during the fiscal year ended June 30, 1915, and upon the work now in progress.

My oath of office was taken March 16, 1915, so that during the greater part of the period covered by this report the Census Bureau was under the management of my predecessor, Hon. William J. Harris; and I am fortunate in being associated with his well-organized and capable official force.

During the fiscal year the Bureau completed its decennial inquiry relating to wealth, debt, and taxation; issued its decennial reports on insane and feeble-minded, paupers, and Indians in the United States; published a decennial bulletin on Negroes in the United States and carried on the compilation of a detailed report on the same subject; completed and issued its decennial "statistical atlas"; completed its quinquennial census of electrical industries; conducted and brought well toward completion its quinquennial canvass of manufacturing industries; carried on its regular annual investigations relating to mortality, municipalities, and cotton and cottonseed; made its semiannual collections and publications of tobacco statistics; undertook a new line of work, the collection of financial statistics of States; took two special censuses of municipalities; and complied with numerous mail requests for information contained in its records.

Since the close of the fiscal year the Bureau has been engaged in compiling the results of the census of manufactures, in the preparation of the Official Register of the United States, which is issued biennially, and in the conduct of annual and special inquiries.

The publications issued during the fiscal year and since its close are listed in Appendix I.

PROGRESS OF ROUTINE WORK.

CENSUS OF MANUFACTURES.

The largest single task undertaken by the Bureau of the Census in the past fiscal year was the quinquennial census of manufactures, relating to the calendar year 1914. In making the preparations for this census, some little inconvenience was caused by the lack of an appropriation for the purchase of city directories from which to

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obtain the names and addresses of manufacturers. With the assistance of the Secretary of Commerce arrangements were finally made by the Bureau to borrow directories from mayors and other officials of some of the cities and to obtain them for other cities from the Library of Congress. This not only facilitated the work, but resulted in a material saving.

A force of more than 1,300 special agents was organized during December, 1914, to collect reports concerning capital invested, persons employed, cost of materials, value of products, character and quantity of power used, and quantity of fuel consumed from every manufacturing establishment in the United States. The proper administration of this force required a great deal of preliminary detail work. The entire United States was laid out into suitable districts. The agents were appointed, received the necessary instructions, and during the latter part of January began their work. The canvass proceeded rapidly—in fact, more rapidly than at any preceding census—and virtually the entire force of local agents was dispensed with by the first of July. In point of rapidity and accuracy of work the record of this investigation promises to be more satisfactory than that of any preceding one.

At present the work of compiling the manufactures statistics is proceeding rapidly. The value of promptness in placing the results of this important inquiry in the hands of the public is fully appreciated, and every effort is being made to expedite the work. Already a large number of press summaries have been issued giving statistics for individual cities.

ELECTRICAL INDUSTRIES.

The compilation of the quinquennial census of electrical industries, relating to the year 1912, which covered central electric light and power stations, street and electric railways, telephones, telegraphs, and municipal electric fire-alarm and police-patrol signaling systems, was completed in August, 1914. The printing, proof reading, checking, and various other detail work in connection with printing, however, consumed so much time that the reports were not issued until April, 1915. Two volumes were published, the first relating to central electric light and power stations and street and electric railways and the second to the remaining subjects named.

WEALTH, DEBT, AND TAXATION.

This decennial inquiry, which related to the fiscal year 1913, was completed during the period covered by this report. The results were published in the form of eight separate bulletins and an abstract. The final copy was sent to the printer on March 15, 1915—less than a year and a half from the beginning of the office work and about a year from the commencement of the field canvass. This establishes a record for rapidity of work.

After the issuance of the entire series of bulletins, their contents were bound together in two volumes having a total of 1,642 pages. The subjects covered comprise the following: Estimated valuation of national wealth, 1850–1912; national and State indebtedness and funds and investments, 1870–1913; county and municipal indebted-

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ness, 1913, 1902, and 1890, and sinking fund assets, 1913; taxation and revenue systems of State and local governments; assessed valuation of property and amounts and rates of levy, 1860–1912; national and State revenues and expenditures, 1913 and 1903, and public properties of States, 1913; county revenues, expenditures, and public properties, 1913; and municipal revenues, expenditures, and public properties, 1913.

The investigation relating to wealth, debt, and taxation is one of the most important made by the Census Bureau during "intercensal" years; and its results have attracted widespread attention, including much press comment.

FINANCIAL STATISTICS OF CITIES.

The preparation of Bulletin 126, presenting financial statistics of cities for the fiscal year 1913, was completed July 30, 1914, and the bulletin was issued in the following September.

The field work on the current investigation under this head, which relates to the latest fiscal period terminating prior to July 1, 1915, was begun early in the present calendar year and is being rapidly completed. It is proposed to have the results of this inquiry in the hands of the printer by December 15 or January 1—an advance of nearly a year as compared with most of the similar reports previously issued.

The cities covered by this investigation, of which there are 204, are those estimated to have over 30,000 inhabitants on the median dates of their fiscal years. The equivalent of about 4,000 days of field work for one employee is required to collect the statistics. As many of the data as possible are secured from printed reports of various cities, thus reducing the cost of field work considerably without impairing the accuracy of the figures obtained.

GENERAL STATISTICS OF CITIES.

This investigation, which relates to the latest fiscal period terminating prior to July 1, 1915, is carried on in connection with the collection of financial statistics of cities, and pertains to the same municipalities, namely, those having over 30,000 inhabitants. The current investigation covers (*a*) character of government—mayor and council or commission, annual salaries of principal officers, etc.; (*b*) police departments—organization, salaries, equipment, requirements for appointment, civil-service regulations, systems of retirement, pensions, etc.; (*c*) liquor licenses and taxes—number of saloons and annual licenses, disposition of receipts, regulations, results of elections on this subject, etc.; and (*d*) water-supply systems—equipment, description of system, purification process, earnings, rates to consumers, etc. Similar statistics were collected for the years 1902, 1903, 1905, 1907, and 1909, but, because of the pressure of the Thirteenth Census work, it was decided not to compile the reports for 1911 and 1913. The annual reports on financial statistics of cities, however, have carried a few statistics of a general character, and it is the purpose to make annual collections hereafter of general statistics on certain subjects for cities of over 30,000.

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COTTON AND COTTONSEED.

During the year the Census Bureau gathered and published statistics relating to cotton ginned, to cotton consumed, imported, exported, and on hand, and active spindles, and to cottonseed and linters. As shown by the official report, the cotton crop of 1914 amounted to over 15,900,000 bales. This was the largest crop ever grown, and in view of the disturbed conditions in foreign countries its disposition was one of the most serious problems confronting the cotton market. Special importance was attached, therefore, to the census statistics relating to cotton.

Notwithstanding the unusual difficulties attending the movement of the crop of 1914, there was no delay in the collection and publication of the data. All of the reports were issued on dates corresponding with those on which they were published in preceding years.

Special attention is called to the consumption of linters for the manufacture of explosives. There is no definite provision of law for the collection of statistics in regard to linters, but the Bureau has acted on the theory that linters properly form a part of the cotton crop, and the data concerning them have been collected in connection with statistics relating to the quantity of cotton ginned. It would be of considerable assistance to the Bureau in carrying on this work if there were a special provision of law requiring the Director of the Census to collect statistics of the quantity of cottonseed crushed and linters obtained and of the distribution of linters. A recommendation to this effect is made on page 468.

TOBACCO.

Under authority of an act of Congress approved April 30, 1912, the Bureau makes semiannual collections and publications of statistics of stocks of leaf tobacco held by manufacturers and dealers. The reports for the fiscal year 1915 related to October 1, 1914, and April 1, 1915, and were issued November 9, 1914, and May 5, 1915, respectively. The Bureau of Internal Revenue of the Treasury Department collects statistics on this subject, and it has recently made some changes in its methods of conducting this work so as to permit it to secure more promptly data concerning stocks of tobacco on fixed dates. The Bureau of Crop Estimates of the Department of Agriculture also collect statistics concerning tobacco, and the Bureau of Foreign and Domestic Commerce of the Department of Commerce has published reports in regard to the tobacco industry of the world. There will necessarily be considerable duplication in the work of the Census Bureau and that of the Bureau of Internal Revenue, and more or less confusion will arise because of the publication of statistical and other information concerning tobacco by the four bureaus referred to.

In order to avoid this duplication, to systematize the work, and to make it possible to publish an authoritative report concerning the production, consumption, and stocks of tobacco, an interdepartmental committee was appointed to consider the entire subject. This committee held several meetings and conferred with representatives of the Tobacco Association of the United States and the National Cigar Leaf Tobacco Association. The report of the committee, which is

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given in full as Appendix II, included recommendations to the effect that the act of April 30, 1912, be repealed and that the Bureau of the Census discontinue the collection of statistics concerning tobacco, except such as are incident to the decennial census of agriculture and the quinquennial census of manufactures; that legislation be enacted providing for the collection and publication, by the Bureau of Internal Revenue, of statistics in regard to the principal types of tobacco held by dealers at the end of each quarter and by manufacturers at the end of each year; and that an annual report containing all the statistical information concerning tobacco collected by the several Federal bureaus be prepared by the Bureau of Crop Estimates.

I concur in these recommendations. (See p. 469.)

VITAL STATISTICS.

The annual report on mortality statistics for 1913 was completed and published early in the present calendar year. In this report there were included, for the first time, mortality statistics for the State of Virginia, which was added to the death-registration area for 1913.

The Index of Joint Causes of Death, intended for use of registrars of mortality statistics, showing the assignments to the preferred title of the international list of causes of death when two or more causes are simultaneously reported, was issued in August, 1914. This publication, an octavo volume of over 300 pages, was "printed as proof," in order to enlist constructive criticism from registrars and others concerned or interested in the recording, transcription, compilation, and publication of mortality data.

The work of preparing the annual report on mortality statistics for 1914 has been somewhat delayed by the sending of about 37,000 circular letters to attending physicians in cases in which the deaths were reported as due to cancer in order to ascertain whether the diagnoses were based on clinical findings or whether autopsies or surgical operations were performed. It is expected, however, that a considerable part of the time thus lost will be made up, and that the report will be ready for the printer by January 1, 1916, or very shortly thereafter.

The Census Bureau's reports relating to vital statistics are constantly being brought to a higher standard of usefulness. Separate statistics are now shown with reference to the white and colored races for all localities in the registration area in the south and for all cities in any part of the country having a colored population of 10,000 or over in 1910. In the report for 1914 data for deaths of nonresidents will be shown separately, so far as it is possible to do so, thus avoiding the injustice which is now done certain cities for which high death rates, due in considerable part to deaths of nonresidents, are shown. This is particularly the case with respect to cities having unusually healthful climates, by reason of which consumptives and other invalids are attracted thither, and with respect to cities as compared with rural localities, since an appreciable percentage of the deaths in city hospitals are of persons resident in near-by small towns and rural territory.

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DEFECTIVE, DEPENDENT, AND DELINQUENT CLASSES.

The law establishing the permanent Census Bureau authorizes the collection decennially of statistics relating to defective, dependent, and delinquent classes. Under this authorization the Bureau has taken special censuses of the insane and feeble-minded in institutions, of paupers in almshouses, of prisoners and juvenile delinquents, and of the blind and the deaf. The work on the censuses of the insane, feeble-minded, and paupers has been completed, and the reports were published early this calendar year. A bulletin on the blind population of the United States was published in February, and more recently a brief bulletin or preliminary statement was issued regarding the census of the deaf. There remain still to be published in this series the complete or final reports on the blind and the deaf and on prisoners and juvenile delinquents. A bulletin giving statistical tables relating to prisoners and juvenile delinquents enumerated on January 1, 1910, has already been published, but the final report to be issued will be much more comprehensive, as it will include, and, in fact, will relate mainly to, offenders sentenced to prisons, jails, or reformatories in the course of the year as distinguished from those confined in such institutions on a given day. The statistics thus obtained, relating as they do to convictions occurring within a definite period, are beyond question more valuable and significant than those of the prison population on a particular date. The latter, considered as an index of criminality, not only do not relate to a definite period of time but distort the relative frequency of different crimes or offenses for the reason that the accumulation of prisoners sentenced for serious crimes and serving long-term sentences extends back for many years, while the minor or less serious misdemeanors as represented in the prison population are all of recent dates. The tabulation of the data for this report has already been completed. In this work the 493,934 persons sentenced to prisons, jails, workhouses, or reformatories in one year are classified according to offense for which committed (homicide, assault, larceny, vagrancy, etc.) and according to sentence (death, life, and years or months of imprisonment), and these facts are further tabulated in combination with the ages of the offenders and their nativity (country in which born), race (white or colored), illiteracy (whether able to read and write), and former occupations. The material thus obtained is of great interest in many ways. The statistics, it is true, can not be regarded as an index of criminality in the sense of showing the volume of crime committed—we have no statistics in this country that will show that—but they do show the amount of crime detected and punished, and they indicate the classes from which the prison population is recruited.

In publishing the data relative to the defective, dependent, and delinquent classes it has been the aim of the Bureau to make its reports something more than a collection of elaborate statistical tables or a mass of figures. The intention has been to present the statistics in such a way that their significance may be readily perceived and to bring out features of special interest by means of text discussion and analysis and summary tables. The reception accorded the publications already issued in this series, especially the reports relating to the insane and paupers and the bulletin on the blind,

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encourages the Bureau to believe that it is meeting with a good degree of success in this undertaking.

As an incident to this work the Bureau is publishing a statistical directory of the State institutions for the care or custody of defective, dependent, and delinquent classes. This directory is described on page 462 in the section relating to new work undertaken during the year and since its close.

NEGROES IN THE UNITED STATES, 1910.

In the last annual report of the Director of the Census reference was made to the plans for a special census report on Negroes in the United States. A bulletin on this subject was issued last April. It was a publication of about 200 pages, which was prepared in order to meet, without further delay, the demand for census statistics relative to the Negro, a demand which before could only be met by sending out several large volumes of census reports in which the statistics for Negroes were more or less buried in a mass of data relating to all classes of population. This bulletin has been a very popular publication, and already more than 12,000 copies have been distributed.

This bulletin, however, is to be followed by a more carefully prepared and complete report which will contain many additional data derived both from published census reports and from manuscript records in the Bureau. The statistics will be compiled and presented with a view to bringing out features of interest and throwing as much light as possible upon the conditions under which the Negroes live and the progress they have made during the past 60 years. The report will show, for the Negro population, growth, 1790–1910; geographical distribution; migration; dispersion and segregation; marriage and divorce; fecundity; intermixture with whites; mortality; educational progress; occupations; agricultural conditions; economic progress; religious affiliations; and criminality, insanity, and pauperism. This report should be a most useful publication and of great permanent statistical value. The Bureau anticipates a widespread demand for it.

INDIANS IN THE UNITED STATES, 1910.

The work on this report, which is based largely on data contained on the special Indian schedule used at the Thirteenth Census, was discontinued in February, 1912, because of the large reduction in the temporary Thirteenth Census force, and little more was done on the report until the close of April, 1914. A bulletin embodying the results of the work already done, however, was issued in June, 1913. The last section of the report was released for printing in October, 1914. There was considerable delay, however, in checking and proof reading, on account of the limited force of clerks available for this work. The report was finally issued on July 3, 1915.

This report covers twelve subjects, namely, population, stock and tribe, blood, sex, age, marital condition, school attendance, illiteracy, inability to speak English, occupations, fecundity and vitality, and Indians taxed and not taxed.

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OCCUPATIONS.

Work was done in preparation of supplementary occupation statistics, showing certain details not brought out in the general report on occupations. This work, however, was suspended early in October, 1914, in order to advance the work on the census of manufactures, and has not since been resumed. The plans for future work on these statistics are discussed on page 464.

STATISTICAL ATLAS, 1914.

The Statistical Atlas, which is issued decennially, was prepared and the great bulk of the copy sent to the printer before the beginning of the fiscal year, but the printing, proof reading, checking, etc., took up so much time that it was not issued until January, 1915. The current edition is a quarto volume containing 99 pages of text and 503 plates carrying maps, charts, and diagrams presenting graphically the more important facts brought out by the various decennial and other census inquiries. It covers the subjects of population, agriculture, manufactures, mines and quarries, cotton production and consumption, financial statistics of cities, vital statistics, religious bodies, marriage and divorce, and insane in hospitals. The purpose of this volume is the presentation of the more significant data collected by the Bureau of the Census in such form that they may be readily grasped and understood by the nonstatistical reader.

OFFICIAL REGISTER OF THE UNITED STATES.

The Official Register of the United States is being prepared in accordance with the requirements of law and will be issued in December.

In this connection I again call attention to the need of a revision of the law relating to this publication. The preparation of the Official Register in its present form involves a considerable amount of work on the part of the executive departments, particularly those which have a large number of outlying services, especially in foreign countries or the dependencies of the United States. Furthermore, each edition of this publication relates to a date some five months earlier than that upon which it is issued, and is about two years and five months out of date by the time the next edition is published. Meanwhile appointments, resignations, transfers, promotions, and other changes in status are continually occurring throughout the Government service. The Official Register, as now published, consists principally of an alphabetical list of all officers and employees in the Federal civil service, exclusive of the Postal Service, together with commissioned officers of the Army, Navy, and Marine Corps, with brief data as to department and bureau or service in which employed, compensation; State or country of birth; congressional district, State, and county from which appointed; and place of employment. The information presented by departments, bureaus, and divisions is restricted to the names, positions, and salaries of the officials. The register is useful, therefore, only to show the superclerical organiza-

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tion and personnel of each department or bureau and to serve as a book of reference in which may be found, under the name of each clerk or other employee, the above-mentioned facts as to location, compensation, etc., on the date to which the register relates. If it it is desired to ascertain how many clerical positions at $900, $1,000, $1,200, etc., there are in a given department or office, or the numbers of persons employed at various rates of compensation under lump-sum appropriations, or the present status of a particular individual, it is necessary to obtain the information elsewhere. The changes in status which occur in the Federal service in the course of two years are many thousands in number.

For these reasons I renew the recommendation in reference to the Official Register made by my predecessor in his annual reports for the fiscal years 1913 and 1914. (See p. 469, this volume.)

METHOD OF DISTRIBUTING THE BUREAU'S STATISTICS.

The usefulness of the statistical work done by the Census Bureau depends to a large extent upon the manner in which its results are disseminated. The easiest way, of course, would be to print the reports and let them remain in the Government Printing Office until they were asked for by persons interested in them. Another way would be to send them, without previous inquiry, to persons whose names were already on the department's mailing lists and also to members of statistical and other associations who might be presumed to have an interest in the subjects covered. The method employed by the Bureau, however, is to send each of the more important of its publications to persons by whom or in whose behalf the publication has been specifically requested and to persons whose names are on the departmental mailing lists and who, upon receipt of an inquiry from the department, express their desire for the particular publication in question. In these cases a printed or multigraphed mailing card with return card attached is used, so that all the recipient has to do is to detach the return portion of the card, sign his name, and mail it, no postage being required. It is assumed that any one who does not care to take this small amount of trouble would have little use for the report.

In some cases another method is employed. This consists in sending a multigraphed circular letter to members of associations, etc., who are presumed to have an interest in the subjects covered by the report. The letter gives a brief description of the report and requests the addressee to notify the Bureau in case he wishes to receive it. This plan was employed, with most gratifying results, in distributing the reports on electrical industries, the insane and feeble-minded, the blind population of the United States, and Indians in the United States. A large percentage of letters thus sent out elicit affirmative replies.

The bureau's periodical reports on cotton, of which 25 are issued annually, and its semiannual reports on tobacco are sent out in the form of mailing cards to vast numbers of growers, dealers, and manufacturers.

Press summaries.—The preparation and distribution of press summaries of the Bureau's reports and bulletins is a matter of no small

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importance, since through this medium the census statistics are placed before millions of readers, whereas the reports and bulletins themselves reach only thousands. These summaries are carefully prepared, with the view of making them readable and easily comprehensible by nontechnical persons, and at the same time preserving absolute accuracy. They range from three-fourths of an ordinary newspaper column to a column or more in length, and most of them are given a very wide circulation. They are often printed in full, but when a paper can not spare sufficient space for the entire summary it usually omits certain paragraphs or parts of paragraphs and prints the remainder verbatim. In this way the danger of presenting garbled and misleading statements of census statistics, hastily prepared by newspaper men unfamiliar with the subjects covered, is practically eliminated.

INFORMATION FURNISHED BY CORRESPONDENCE.

An important branch of the Bureau's work is the furnishing of information by correspondence. Many thousands of requests for population data have been received and complied with since the Thirteenth Census was taken. A great many requests are also received for genealogical data and for transcripts of census records regarding ages of soldiers, to be used in connection with applications for pensions and increases of pensions.

WORK IN THE MACHINE SHOP.[a]

A new-model tabulator head has been constructed in the machine shop. This machine in its present form has been in use for several weeks in the tabulation of mortality statistics and has operated in a very satisfactory manner. It presents a number of advantages as compared with the earlier model.

NEW WORK UNDERTAKEN DURING THE YEAR AND SINCE ITS CLOSE.

FINANCIAL STATISTICS OF STATES.[b]

The collection of financial statistics of States, similar in scope to the financial statistics of cities which are gathered annually by the Bureau, was authorized by the Secretary of Commerce on June 20, 1915, and the work was immediately begun. The statistics cover (1) total and per capita receipts from revenues, in detail; (2) total and per capita payments for expenses, interest, and outlays, in detail; (3) assets and liabilities; and (4) total and assessed valuations of property subject to taxation, tax levies, methods of assessment, etc. The statistics will relate to the latest fiscal period terminating prior to July 1, 1915, and it is the purpose to have them ready for distribution in January, 1916.

This work was taken up at the request of many prominent associations, State officials, and accountants, and there is no question that

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[a] See also p. 465.

[b] See also p. 468.

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the statistics obtained will be of great value, not only on their own account, but also in connection with those relating to municipalities of 30,000 or over.

LIFE OR MORTALITY TABLES.

An important piece of work now nearing completion is the preparation of a series of life, or mortality, tables, based on the population of 1900 and 1910, and the mortality statistics of 1900, 1901, and 1902, and of 1909, 1910, and 1911. These tables present data for various elements of the population—male and female, white, Negro, urban, rural, etc.—in the original registration States (Connecticut, Indiana, Maine, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Rhode Island, Vermont, and the District of Columbia) as they existed in 1900, taken as a group. Certain of these States, ranking high in population, such as New York, Massachusetts, Michigan, Indiana, and New Jersey, as well as the cities of Boston, Chicago, New York, and Philadelphia, will also be represented individually. Among the results shown in the tables will be the death rate and expectation of life at each age. These tables are similar to those published by the European countries, and their preparation, which is under the charge of Prof. James W. Glover, of the University of Michigan, involves actuarial computation of an intricate character. This will be the first time that life tables of such an extensive nature have been published by any Federal or State bureau. It is expected that these tables will be ready for the printer by February 1, 1916.

MONOGRAPH ON CANCER.

A statistical monograph on cancer, relating to the calendar year 1914, is being compiled and will probably be ready for the printer by the close of the present calendar year. In addition to showing the number of deaths from cancer throughout the registration area and in each of its subdivisions, this monograph will present information of a more detailed character than that given in the Bureau's annual reports on mortality.

The American Public Health Association, which has always been active in cooperating with the Census Bureau in connection with its work on vital statistics, is especially interested in this bulletin. At the recent meeting of that association in Rochester, N. Y., held early in September, 1915, the section on vital statistics adopted the following resolution:

Whereas the American Public Health Association at its last annual meeting recommended the closest possible cooperation between the Bureau of the Census and the registration officials of the several States in order to improve the collection and publication of vital statistics in the United States; and

Whereas the Director of the Census, at the suggestion of students of the cancer problem, has recently undertaken with commendable interest and zeal the improvement of cancer mortality statistics and the publication of detailed tables in a special report thereon for the year 1914, which promises to be a notable contribution to the study of malignant disease, indicating that similar special tabulations of other diseases will be made in the future; and

Whereas certificates of death from cancer and other diseases are frequently so incomplete as to necessitate query letters to the medical attendant to obtain fuller details, and it is desirable to avoid delay and duplication of effort by coordinating the

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work of the Federal and State authorities in a uniform administrative plan which will insure the earliest possible receipt of accurate statements of causes of death and the prompt sending of a uniform query for fuller details when necessary; Therefore, be it

Resolved, That the section on vital statistics and the section of public health officials recommend that a committee of the American Public Health Association be appointed to confer with the Director of the Census relative to the appointment of appropriate State officials as cooperating statisticians of the Bureau of the Census, who as Federal agents shall be empowered to use the franking privilege of the Federal Government for the sole purpose of obtaining necessary supplemental information on certificates of death in the fulfillment of Federal requirements, and further recommends that the Federal and State authorities cooperate in such other procedures as will contribute to the better registration of vital statistics in the United States.

DIRECTORY OF INSTITUTIONS.

The Bureau is publishing a statistical directory of State institutions for the care and custody of defective, dependent, and delinquent classes. This directory will show for each institution the number of inmates; cost of maintenance; number of officials, assistants, or employees; acreage of grounds or land; and other data, all of which have been supplied by the officials of the institutions and will be published with their knowledge and consent. It will show the cost of maintenance per inmate and the total cost of maintaining such institutions in each State computed as a per capita of the total population of the State and also as a ratio of the total wealth of the State.

INDEX TO OCCUPATIONS.

A revised occupation index was issued, showing in alphabetical order the 9,000 or more occupational designations covered by the work of the Thirteenth Census and classifying these occupational designations into the 428 occupations and occupation groups listed in the occupations report of that census. This index will be used by the Bureau of the Census, by other Federal and State bureaus, and by associations, societies, institutions, etc., which desire to classify occupations in conformity with the classification followed by the Census Bureau.

CENSUSES OF TULSA, OKLA., AND HAMTRAMCK, MICH.

A special census of Tulsa, Okla., was taken in April, 1915, by direction of the President, at the request of the Tulsa Commercial Club. The work was done by local enumerators under the supervision of an official of the Census Bureau, and the entire expense was met by the city. This census established a precedent, in that it was the first Federal enumeration of the population of a city, separately from that of the State in which located, ever made between decennial census years. A similar census of Hamtramck, Mich., was taken in June, 1915.

PLANS FOR FUTURE WORK.

RELIGIOUS BODIES.

Preparatory work on the decennial census of religious bodies, relating to the calendar year 1916, will be begun as soon as possible. A widespread interest in this census is already being manifested. At

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the conference of the committees of the Federal Council of the Churches of Christ in America, recently held at Atlantic City, N. J., the subject of a church census was discussed, representatives of the Bureau being present by invitation, and as a result of this discussion the conference adopted the following special finding:

It is the judgment of this conference that the administrative committee of the Federal Council should take up with the constituent bodies of the council, the various commissions of the council, and the organizations here represented the matter of making suggestions to the Bureau of the Census at Washington concerning information on religious subjects that might, if gathered in the religious census of 1916, prove valuable to the various religious agencies of the country.

Preparations for taking this census will be made as rapidly as possible, in order that there may be no delay when the time arrives to begin the actual canvass.

FOREST PRODUCTS.

The Bureau desires to take up again the annual collection of statistics of forest products, which was discontinued after the publication of the report for 1912, by reason of the absence of any specific provision of law authorizing the inquiry. These statistics were collected by the Census Bureau in cooperation with the Forest Service of the Department of Agriculture for the years 1907 to 1912, inclusive. The Forest Service thereupon undertook the task of collecting the statistics for 1913. Those for 1914 have been gathered in connection with the quinquennial census of manufactures, but in the absence of legislation it will be impossible for the Census Bureau to obtain them for 1915 or any subsequent year in which a census of manufactures is not taken.

These statistics are in great demand by large consumers of forest products and others interested in the conservation of natural resources. The Forest Service has requested the renewal of this annual work and has recommended legislation authorizing it. Under the head of "Legislation needed" (p. 468) I am making a similar recommendation.

MARRIAGE AND DIVORCE.

The first Federal investigation of marriage and divorce as a distinct subject was made in 1887 by the Department of Labor and covered the 20 years from 1867 to 1886, inclusive. The next was made 20 years later by the Bureau of the Census and covered the period from 1887 to 1906, inclusive. Each of these investigations was specifically authorized by Congress, but no provision was made for future inquiries relating to this highly important subject. No argument is needed to demonstrate the desirability of making this inquiry at regular intervals. Legislation is therefore recommended (see p. 468) authorizing the decennial collection of statistics of marriage and divorce, beginning in 1917. The period covered by the next inquiry would thus be 1907 to 1916, inclusive, making a total of 50 years—from 1867 to 1916, inclusive—for which these statistics would be available.

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WATER TRANSPORTATION.

The next decennial census of water transportation will relate to 1916. The work of preparing schedules and organizing a field force will begin shortly before or immediately after the close of the current fiscal year.

MONOGRAPH ON TUBERCULOSIS.

A statistical monograph on tuberculosis, relating to the calendar year 1915, is to be prepared. This monograph, like that on cancer, will show, in addition to the number of deaths from tuberculosis in the registration area and in each of its subdivisions, various detailed statistics not given in the regular report on mortality.

SUPPLEMENTARY STUDIES OF OCCUPATION STATISTICS.

As stated under the heading "Occupations" (p. 458), some work has been done in the compilation of occupation statistics supplemental to those published in Volume IV of the Thirteenth Census reports. This work was begun in March, 1914, but was suspended early in October, 1914, and has not since been resumed. These statistics cover (*a*) a more detailed age classification, to be presented in connection with the classification by color or race, nativity, and parentage; (*b*) a tabulation by marital condition; (*c*) data as to unemployment, showing unemployment on census day (Apr. 15, 1910), and number of weeks unemployed during the year 1909; (*d*) status of worker—that is, whether an employer, working on own account, or a wage earner. So much work has already been done in the compilation of these data that it is deemed desirable to finish the undertaking. The Bureau is still receiving, even at this late date, many inquiries for statistics of this character from associations and individuals. Not only will such statistics have some considerable value in themselves, but they will furnish a basis for the compilation of data regarding child labor. Furthermore, these statistics, together with those already compiled and published, will provide a complete basis for comparison with the occupation statistics derived from the census of 1900, as well as with those which will be obtained at future censuses.

It is not the intention to take up this special study of Thirteenth Census statistics at the expense of delaying the tabulation of the current manufactures census, now under way; but it is deemed desirable to resume the occupation work in the near future if this can be done without hampering the Bureau in the performance of the duties devolved upon it by law and for the discharge of which its annual appropriations are made.

CHILD LABOR.

The Bureau desires, if the pressure of other work is not too great, to issue a bulletin on child labor, based on the occupation statistics of the Thirteenth Census. There were in 1910 about 2,000,000 children under 16 years of age who were employed in gainful occupations, and statistics showing the distribution of these children according to color and nativity in connection with age expressed in single years will be of great significance and value as a basis for legislation and child-welfare work.

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CHILDREN BORN AND LIVING.

An important special tabulation which the Bureau of the Census is planning to make in the near future will show, for various race and nativity classes and age groups, for urban and rural localities, etc., the number of children borne by women enumerated at the last census and the number still living on the census date. Statistics of this character will throw much light on such subjects as the decline in the birth rate, fecundity of native as compared with foreign-born women, vitality of native stock as compared with foreign, infant and child mortality, etc.

MACHINE SHOP.

It will be necessary soon to begin the construction of new tabulating machinery and the remodeling and repair of machinery already on hand in order that the Bureau may be prepared to tabulate the results of the Fourteenth Census, to be taken in 1920. Although more than four years will elapse before this tabulation will commence, the amount of work to be done in constructing new machines and remodeling and repairing old ones is so great that it should be begun at an early date. A portion of the Bureau's tabulating equipment—namely, the sorting machines and automatic tabulating machines—has been brought to a high state of perfection. The number of sorting machines (17) is sufficient, but these machines require a thorough overhauling. Of the automatic tabulating machines, however, the Bureau will need 25 more. Several of these machines were used in tabulating the results of the Thirteenth Census, and their efficiency was thoroughly demonstrated. Four of them are now in use in tabulating mortality statistics, including one with the new-model head (p. 460), which has proved highly satisfactory. The automatic punching machines used at the last census must be not only overhauled but in some respects remodeled, in order to eliminate certain defects.

A very considerable increase in the force of the machine shop will be needed to take care of this extra work, but it is believed to be preferable to do the work at the Bureau rather than elsewhere, for the reason that an exact knowledge of what is required, coupled with direct supervision, must necessarily result in a better product.

The employment of the Bureau's own tabulating machinery in preference to renting such machinery from outside firms results in a material saving.

OFFICE ACCOMMODATIONS AND STORAGE SPACE.

Although the increase in the Bureau's office force incident to the next census of population will not take place until 1919, the tabulation of the manufactures census—a very large piece of work—is now under way, and several other very important investigations—the censuses of religious bodies and water transportation, as well as the inquiry relating to marriage and divorce, in case that is authorized by law—will begin in the near future. It becomes necessary, therefore, to give immediate and serious consideration to the matter of an increase in office accommodations.

More storage space is also needed. At present most of the Bureau's tabulating machinery is stored in the Department's stables; and the agricultural schedules for 1910, as well as a large number of records

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and files, are stored in the Washington Light Infantry Armory Building, at the corner of Fifteenth and E Streets NW. While it is not necessary to consult these records and files frequently, reference is occasionally made to them. The population schedules, which form a portion of the Bureau's permanent records, are stored in the Commerce Building. All these schedules, excepting those for 1890 and 1910, are bound and are so arranged as to be readily accessible. About five-sixths of the 1890 schedules, although unbound, are properly filed, and the remainder are so arranged that a given schedule can be found in a comparatively short time. The 1910 schedules are in order, but not in convenient form for easy reference. These schedules are consulted frequently for the purpose of supplying information as to ages of pension applicants, genealogical data, etc. It is important, therefore, that they be readily accessible. All the space available for them is now occupied, leaving none for the schedules of the next census.

OFFICE FORCE.

The appropriation act for the fiscal year 1915 provided for 589 permanent officials and employees of the Census Bureau; the number provided by the act for 1916, under which the Bureau is now operating, is 569.

The Census Bureau is seriously handicapped in carrying on its work not only by reason of the inadequacy of its force at times, as during a quinquennial census of manufactures, but also because of its exceedingly low average salary scale. The percentage of the Bureau's force receiving more than $1,200 per annum, as provided for by the appropriation act for the fiscal year 1916, is only 14.8. This percentage is hardly more than three-fifths as high as that for the other bureaus and offices of the Department of Commerce taken as a group (24), and is much lower than that for any other individual bureau or office of the Department.

With respect to other departments and bureaus, the latest figures in the possession of the Census Bureau relate to February, 1912, at which time the percentage for positions above $1,200 in all the executive departments combined, exclusive of the Census Bureau, was 36.1. The corresponding percentage in the Census Bureau at the present time is only 14.8, or a little more than two-fifths of the February, 1912, percentage for the remainder of the departmental service. These percentages are based on the number of employees in the District of Columbia only. It is safe to say that in no other Federal bureau or office of equal or greater size is the salary scale for the official and clerical forces so low as in the Census Bureau.

During the past fiscal year the Bureau lost 34 clerks by transfer to other Government offices, one official and 15 clerks by resignation, and 2 officials and 4 clerks by death. Of the clerks transferred, 2 were receiving $1,600 per annum; 3, $1,400; 18, $1,200; 2, $1,000; and 9, $900. Of these 34 clerks, 1, whose salary in the Census Bureau had been $1,600, was transferred to an $1,800 position; 2, receiving $1,200 in the Census Bureau, were transferred to $1,600 positions; 2, receiving $1,200 in the Census Bureau, were transferred to $1,400 positions; and 1, whose salary in the Census Bureau had been $1,000, was transferred to a $1,200 place. In three cases the salary paid the transferred

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employee in his new position is not known to the Bureau. In the other 25 cases the employee was transferred at the salary he had been receiving, but in most, if not all, of these cases the prospects of promotion appeared brighter in the new position than in the Census Bureau.

Of the 16 persons who resigned, 1 was a chief statistician at $3,000, 1 a clerk at $1,400, 4 were clerks at $1,200, 2 were clerks at $1,000, and 8 were clerks at $900. Of these 16 resignations, 7 were of men and 9 were of women. Although in many cases the Bureau has no official knowledge of the work in which these persons are at present engaged, it may be safely assumed that all or nearly all the men, and probably some of the women, have obtained more lucrative positions—or, at least, positions which offered better prospects of advancement—than those which they had at the Census Bureau. Of the 6 deaths, 2 were of chiefs of division at $2,000, 3 of clerks at $1,200, and 1 of a clerk at $900.

It is impossible to lay too great stress on the injustice, both to the Bureau as an office and to its personnel as individuals, which results from this state of affairs. On the one hand, the Bureau has lost a considerable number of its experienced employees, and has thus become, to that extent, a training school for governmental bureaus and commercial institutions with more liberal salary scales. Many of these employees had become especially valuable and efficient as a result of their long service, and their places can not be adequately filled by the simple process of promotion or appointment. Months, and even years, of training will be necessary to fit their successors to discharge their duties with the desired degree of efficiency. On the other hand, the employees who remain are, in many cases, drawing far less pay than is given for comparable service in other bureaus in this and other departments. From the standpoint of the employees, this is unjust; and from the standpoint of the Bureau, it is a disadvantage, in that it tends to engender a spirit of discontent and indifference. Most employees will not develop their maximum possible efficiency when they believe themselves to be illtreated.

In addition to being handicapped by a low salary scale, the Census Bureau's statutory force is too small to handle the constantly increasing amount of work devolving upon it. Not only are new lines of work assigned to the Bureau from time to time by congressional enactment and by direction of the President or the Secretary of Commerce, but the amount of work represented by each of the old lines is constantly increasing with the growth of the country. Yet the Bureau's statutory force for the fiscal year 1916 numbers only 569, whereas 10 years ago, in the fiscal year 1906, it had 691 statutory employees. At that time, as at the present, the Bureau was busily engaged in taking and tabulating a census of manufactures. Since the fiscal year 1906, however, two new lines of work—the biennial compilation of the Official Register of the United States and the semiannual collection and publication of tobacco statistics—have been assigned by Congress to the Census Bureau. Furthermore, as just stated, the work of carrying on the original investigations, such as the censuses of population, manufactures, agriculture, etc., is materially greater than it was 10 years ago, by reason of the increases in population and industry which have taken place during the past decade. Fortunately, the Census Bureau has been able, through improve-

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ments in organization and methods, to neutralize in part the disadvantage under which it labors in respect to the size of its force. The difficulty is, nevertheless, a grave one, and its seriousness is steadily increasing.

In its estimates for appropriations for the fiscal year 1917 the Bureau has not asked for an increase in its force or in its total appropriation for salaries, although both are sorely needed. It has, however, recommended a change in the distribution of the amount appropriated so as to provide a greater number of places at $2,000, $1,800, $1,600, $1,400, $1,000, and $900, and a smaller number at $1,200. The present $1,200 class is inordinately large in comparison with the others. In fact, the line between this and the $1,400 class constitutes a sort of "dead line" which a great many of the Bureau's employees have little or no hope of passing. The present and proposed classifications are shown in Appendix III. Under the proposed plan, if it is put into effect, it will be necessary to make a number of reductions from $1,200 to $1,000 and from $1,000 to $900 on July 1, 1916. The Bureau will, however, prepare for the change by making temporary instead of permanent promotions to vacancies occurring in the $1,200 and $1,000 classes before the close of the present fiscal year. The persons so promoted will then accept reduction on July 1 as a matter of course. Others will have to be reduced also, but these will be restored to their former salaries at the earliest opportunity. A total of 45 promotions of $200 per annum will be provided for by this plan, and they can not fail to have an immediate and regenerative effect on the Bureau's personnel. While, as has already been pointed out, the present force is too small, a still more serious handicap is the tendency of the officials and clerks to leave for more profitable employment elsewhere; and this tendency will be materially checked by the adoption of the plan described.

The nature and distribution of the Bureau's office and field force on September 30, 1915, are shown in Appendix IV.

LEGISLATION NEEDED.

MARRIAGE AND DIVORCE.[a]

The decennial collection of statistics of marriage and divorce should be authorized.

FOREST PRODUCTS.[a]

The annual collection of statistics of forest products should be provided for by law.

STATE FINANCE.[b]

The annual collection of statistics of State finance should be authorized by appropriate legislation.

COTTONSEED AND COTTONSEED PRODUCTS.[c]

The collection of statistics of cottonseed and cottonseed products at intervals during the ginning and crushing season should also be authorized. A bill for the collection of such statistics was introduced in the Sixty-third Congress.

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[a] See also p. 463. [b] See also p. 460. [c] See also p. 454.

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OFFICIAL REGISTER OF THE UNITED STATES.

For the reasons stated on pages 458 and 459, I renew the following recommendation of changes in the scope of the Official Register, made by my predecessor in his annual reports for the fiscal years 1913 and 1914:

The enactment of legislation authorizing—

(1) The establishment of a card directory, prepared and maintained by the Civil Service Commission from information furnished by the executive departments and independent offices, showing the name and status of every person in the Government service except the officers and enlisted men of the Army, Navy, Marine Corps, and Coast Guard. (Lists of officers of the Army, Navy, and Marine Corps are already published annually in the Army Register and Navy Register, issued by the War and Navy Departments, respectively.)

(2) The elimination from the Official Register of detailed lists of all employees, by name.

(3) The publication annually by the Bureau of the Census of an Official Register containing—

(*a*) A list of all employees of the Government (except officers and enlisted men in the Army, Navy, Marine Corps, and Coast Guard) whose duties are of an executive, supervisory, technical, or professional character, and whose compensation is $2,000 or more per annum.

(*b*) Statistics relating to the Government service, to be prepared from the Civil Service Commission's card directory.

The proposed plan, if adopted, will result in very material saving to the Government, will at the same time preserve all the valuable features of the present Official Register, and will provide for a complete and up-to-date record of the entire personnel of the Government in one central office (the Civil Service Commission) in such form that the Bureau of the Census, by the aid of its tabulating machinery, can quickly and accurately compile statistics relative to Federal employees when called upon to do so by the President or by Congress.

STATISTICAL COMPILATIONS FOR STATE OFFICIALS AND PRIVATE INDIVIDUALS.

Express, rather than implied, authority should be given the Director of the Census to furnish transcripts of tables and other records and to prepare special statistical compilations for State officers and private individuals, and the provision should be so drawn as to make the amounts received for work thus done for outside parties actually serviceable to the Bureau, instead of only nominally so, as at present. The authority under which the Bureau now performs this work is found in section 32 of the Thirteenth Census Act.

TOBACCO STATISTICS.[a]

The act of April 30, 1912, providing for the collection of statistics of stocks of leaf tobacco in the hands of manufacturers and dealers on April 1 and October 1 of each year should be repealed and legislation should be enacted authorizing the Bureau of Internal Revenue of

[a] See also p. 454.

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the Treasury Department to collect statistics in regard to the principal types of tobacco held by dealers and manufacturers.

EXPRESS BUSINESS.

The requirement of the decennial collection of statistics relating to the business of express companies, now contained in the act of June 7, 1906, should be repealed. Annual statistics of this character are collected and published by the Interstate Commerce Commission, and the decennial conduct of a similar investigation by the Census Bureau is wholly unnecessary.

APPROPRIATIONS AND EXPENDITURES.

FINANCIAL STATEMENT, FISCAL YEAR 1915.

In Appendix V is presented a financial statement for the Bureau of the Census, covering the fiscal year ended June 30, 1915.

APPROPRIATIONS, FISCAL YEAR 1916.

The appropriations for the fiscal year 1916 amounted to $1,198,740. The appropriation for salaries was decreased from $690,846.67 to $674,740 because of the transfer of 7 clerical and 13 subclerical positions to the roll of the Department of Commerce.

The item for tabulating machines remained unchanged, at $12,000.

The appropriation for collecting statistics was reduced from $835,000 to $512,000, of which amount $150,000 was made immediately available for the completion of the manufactures canvass.

The item for the purchase of books and periodicals was discontinued, all expenses connected with the library now being paid from the appropriation for the Department of Commerce.

Respectfully,

SAM. L. ROGERS,
Director of the Census.

To Hon. WILLIAM C. REDFIELD,
Secretary of Commerce.

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APPENDIXES.

APPENDIX I.

PUBLICATIONS ISSUED.[a]

JULY 1, 1914, TO JUNE 30, 1915.

Class and title.	Date issued.	Pages.	Edition.
Bound volumes:			
Occupation statistics, 1910 (Vol. IV, Thirteenth Census reports) (quarto)	July 7, 1914	615	6,000
Insane and feeble-minded, 1910 (quarto)	Jan. 8, 1915	217	6,000
Paupers in almshouses, 1910 (quarto)	Mar. 10, 1915	141	5,000
Central electric light and power stations and street and electric railways, 1912 (quarto)	Apr. 13, 1915	440	6,500
Telephones and telegraphs and municipal electic fire-alarm and police-patrol signaling systems, 1912 (quarto)r	Apr. 17, 1915	208	5,500
Statistical Atlas of the United States, 1914 (quarto)	Jan. 7, 1915	642	7,500
Summary of State laws relating to dependent classes, 1913 (octavo)	Dec. 17, 1914	346	6,000
Mortality statistics, 1913 (quarto)	Feb. 18, 1915	631	6,000
Index of joint causes of death (octavo)	Aug. 27, 1914	308	1,000
Total		3,548	49,500
Unbound quarto bulletins:			
Thirteenth Census (unnumbered)—			
Age of farmers, by color of operator, character of tenure, and size of farm	Aug. 13, 1914	35	5,000
Occupation statistics (abstract of full report)	Aug. 14, 1914	107	3,000
Occupation statistics—Cities of 100,000 inhabitants or more (reprint of Table III from full report)	July 21, 1914	57	1,000
Occupation statistics—Cities of 25,000 to 100,000 inhabitants (reprint of Table IV from full report)	....do.....	85	1,000
Occupation statistics—Alaska, Hawaii, and Porto Rico (reprint of Tables V and IX from full report)	July 10, 1914	18	500
Wealth, debt, and taxation (unnumbered)—			
Abstract of special bulletins, 1913	Feb. 24, 1915	63	20,000
National and State indebtedness and funds and investments, 1870–1913	July 10, 1914	203	6,000
Taxation and revenue systems of State and local governments.	Oct. 30, 1914	275	18,000
National and State revenues and expenditures, 1913 and 1903; and public properties of States, 1913	Dec. 17, 1914	44	5,000
County and municipal indebtedness, 1913, 1903, and 1890, and sinking fund assets, 1913	Apr. 10, 1915	228	9,000
County revenues, expenditures, and public properties, 1913..	Apr. 20, 1915	338	5,000
Assessed valuation of property and amounts and rates of levy, 1860–1912	.....do.....	176	10,000
Municipal revenues, expenditures, and public properties, 1913.	May 1, 1915	378	7,000
Estimated valuation of national wealth, 1850–1912	May 22, 1915	20	10,000
Annual and decennial (numbered)—			
Bulletin 125. Cotton production, 1913	July 23, 1914	79	60,000
Bulletin 126. Financial statistics of cities, 1913	Sept. 14, 1914	73	8,000
Bulletin 127. Chinese and Japanese in the United States, 1910.	Nov. 5, 1914	50	5,500
Bulletin 128. Supply and distribution of cotton for the year ending Aug. 31, 1914	Dec. 17, 1914	30	60,000
Bulletin 129. Negroes in the United States, 1910	Apr. 23, 1915	207	15,000
Bulletin 130. The blind population of the United States, 1910..	June 24, 1915	52	7,000
Total		2,518	256,000
Miscellaneous publications:			
Index to occupations, alphabetical and classified (octavo)	May 28, 1915	414	725
The Story of the Census, 1790–1915 (octavo)	Apr. 6, 1915	36	20,000
List of publications—Circular of information, No. 2 (octavo)	Oct. 28, 1914	91	5,000
Annual report of the Director of the Census to the Secretary of Commerce, fiscal year 1914 (octavo)	Oct. 31, 1914	29	2,000
25 reports, in card form, relating to cotton and cottonseed	July 14, 1914 / June 14, 1915	25	1,000,000
2 reports, in card form, relating to stocks of leaf tobacco	Nov. 9, 1914 / May 5, 1915	2	47,500
Total		597	1,075,225
Grand total		6,663	1,380,725

[a] In addition to the publications listed, the Bureau has issued during the fiscal year and since its close a large number of press summaries of its reports and bulletins. (See p. 459.)

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Publications issued—Continued.

JULY 1, 1915, TO SEPTEMBER 30, 1915.

Class and title.	Date issued.	Pages.	Edition.
Bound volumes (quarto):			
Indians in the United States, 1910	July 3, 1915	285	5,000
Wealth, debt, and taxation, 1913—Vol. I	July 9, 1915	886	2,500
Wealth, debt, and taxation, 1913—Vol. II	July 20, 1915	756	2,500
Total		1,927	10,000
Unbound bulletins and pamphlets:			
Leaf tobacco held by manufacturers and dealers, Apr. 1, 1915 (octavo)	July 1, 1915	22	12,500
Special census of the population of Tulsa, Okla., taken Apr. 15, 1915 (octavo)	Aug. 3, 1915	15	2,000
Advance tables of cotton ginned from the crop of 1914 (quarto)	July 10, 1915	30	42,500
Census of the deaf and dumb (quarto)	Sept. 3, 1915	8	2,500
Total		75	59,500
Grand total		2,002	69,500

APPENDIX II.[a]

REPORT OF THE INTERDEPARTMENTAL COMMITTEE.

We have examined the reports issued by the Federal Government which contain statistics and other information in regard to the growth, harvesting, warehousing, manufacturing, exports, and imports of tobacco, also the reports which contain information in regard to the tobacco industry of the world.

We have conferred with representative committees of the Tobacco Association of the United States and of the National Cigar Leaf Tobacco Association, who made recommendations for the improvement of the statistical reports concerning tobacco now being published by the Federal Government.

We have examined the laws authorizing the collection of statistical and other information concerning tobacco. The statistics being compiled by the Bureau of the Census, of the Department of Commerce, in compliance with the act of Congress approved April 30, 1912, are incomplete and, to a certain degree, misleading because they do not relate to the tobacco held by all dealers and manufacturers or by the original growers. These statistics are supposed to represent the stocks of tobacco held April 1 and October 1 of each year—the stocks being distributed by the principal types. The Bureau of Internal Revenue, of the Treasury Department, collects quarterly complete statistics of the stocks held by dealers in leaf tobacco. The work of the Bureaus of the Census and Internal Revenue, therefore, in so far as it relates to the total stocks of tobacco, is a duplication, and the incomplete statistics compiled by the Bureau of the Census can not agree with the complete report of the Bureau of Internal Revenue; therefore the publication of the two totals, both of which purport to show stocks of tobacco, is misleading to the public and necessarily will result in adverse criticism of the statistical reports of the Federal Government.

We find that the Treasury Department and the Departments of Agriculture and Commerce publish reports containing statistical and other information in regard to the tobacco industry. These reports, in some instances, are issued at fixed times and relate to definite periods. Some of them, however, are issued to meet what is supposed to be a demand for information concerning certain phases of the tobacco industry and are issued at such times as they can be most conveniently prepared. The information contained in these reports is, to a certain extent, a reproduction of the data contained in other Government reports.

After considering all of these matters, the committee make the following recommendations:

First. That the act of Congress approved April 30, 1912, be repealed and that the Bureau of the Census discontinue the collection of statistics concerning tobacco, except such as are incidental to the decennial census of agriculture and the quinquennial census of manufactures.

[a] See p. 454.

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Second. That arrangements be made by the enactment of additional legislation for the Bureau of Internal Revenue, of the Treasury Department, to so extend the statistics collected by it as to secure data in regard to the principal types of tobacco held by dealers at the end of each quarter and by manufacturers at the end of each year; also that the Bureau of Internal Revenue arrange to publish this information as quickly as possible after it has been secured.

Third. That an annual report be prepared by the Bureau of Crop Estimates, of the Department of Agriculture, which shall contain in quite elaborate form all of the statistical information concerning tobacco collected by the several bureaus of the Federal Government.

APPENDIX III.

PROPOSED CHANGE IN DISTRIBUTION OF APPROPRIATION FOR SALARIES.

Grade.	Office force, 1916.			Estimates, 1917.		
	Number.	Salary.	Amount.	Number.	Salary.	Amount.
Director	1	$6,000	$6,000	1	$6,000	$6,000
Chief statisticians	4	3,000	12,000	4	3,000	12,000
Chief clerk	1	2,500	2,500	1	2,500	2,500
Geographer	1	2,000	2,000	1	2,000	2,000
Stenographer	1	1,500	1,500	1	1,500	1,500
Expert chiefs of division	8	2,000	16,000	10	2,000	20,000
Clerks	11	1,800	19,800	15	1,800	27,000
Clerks	20	1,600	32,000	27	1,600	43,200
Clerks	37	1,400	51,800	48	1,400	67,200
Clerks	300	1,200	360,000	236	1,200	283,200
Clerks	83	1,000	83,000	113	1,000	113,000
Clerks	82	900	73,800	92	900	82,800
Skilled laborers	3	900	2,700	3	900	2,700
Skilled laborers	2	720	1,440	2	720	1,440
Messengers	3	840	2,520	3	840	2,520
Assistant messengers	5	720	3,600	5	720	3,600
Unskilled laborers	3	720	2,160	3	720	2,160
Messenger boys	4	480	1,920	4	480	1,920
Total	569	.....	674,740	569	.....	674,740

APPENDIX IV.

STATEMENT SHOWING NATURE AND DISTRIBUTION OF OFFICE AND FIELD FORCE, SEPTEMBER 30, 1915.

OFFICIALS.

Director.....SAM. L. ROGERS.
Chief clerk.....WILLIAM L. AUSTIN.
Chief statisticians:
  Population.....WILLIAM C. HUNT.
  Statistics of cities.....STARKE M. GROGAN.
  Manufactures.....WILLIAM M. STEUART.
  Vital statistics.....RICHARD C. LAPPIN.
Expert special agent in charge of revision and results.....JOSEPH A. HILL.
Geographer.....CHARLES S. SLOANE.
Experts chiefs of division:
  Administrative.....EUGENE F. HARTLEY.
  Population.....WILLIAM H. JARVIS.
    EDWARD W. KOCH.
  Statistics of cities.....ARTHUR J. HIRSCH.
  Manufactures.....FRANK L. SANFORD.
    GEORGE E. OLLER.
  Vital statistics.....GEORGE H. VAN BUREN.
  Revision and results.....HARRY H. PIERCE.
Chief, mechanical laboratory.....E. M. LABOITEAUX.

CLERICAL FORCE.

Stenographer, $1,500..... 1
Clerks:
  Class 4..... 11
  Class 3..... 20
  Class 2..... 37
  Class 1..... 300
Clerks:
  $1,000..... 83
  $900..... 82
  Total..... 534

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SUBCLERICAL FORCE.

Skilled laborers:		Assistant messengers, $720	5
$900	3	Messenger boys, $480	4
$720	2		
Unskilled laborers, $720	3	Total	20
Messengers, $840	3		

MECHANICAL LABORATORY FORCE.

Expert, $1,600	1	Electrician, $1,200	1
Electrical expert, $1,600	1	General mechanic, $1,000	1
Mechanical expert, $1,400	1		
Mechanician, $1,400	1	Total	6

SPECIAL-AGENT FORCE.

Expert agents for general field work, etc	22
Temporary agents for census of manufactures	141
Total	163

SUMMARY OF CENSUS FORCE.

Officials	17	Special agents (general force)	22
Clerical	534	Special agents (temporary force)	141
Subclerical	20		
Machine shop	6	Total	740
Special agents to collect statistics of cotton			749

APPENDIX V.

FINANCIAL STATEMENT, FISCAL YEAR 1915.

Administrative:		
Salaries for administrative places	$39,294.12	
Salaries for division of correspondence and mail	16,457.34	
Salaries for labor force	4,363.16	
Stationery	9,855.16	
Miscellaneous expenses	5,511.77	
Books and periodicals	500.00	
		$75,981.55
Machine shop:		
Salaries	11,711.11	
Materials, supplies, etc	165.47	
		11,876.58
Population division:		
Supervision	7,322.21	
Occupations	17,209.02	
Miscellaneous	9,149.14	
		33,680.37
Manufactures division:		
Supervision	9,675.30	
Quinquennial census of manufactures	743,511.04	
Cotton statistics	256,983.37	
Tobacco statistics	11,695.40	
Electrical industries, completion of	2,879.42	
		1,024,744.53
Division of vital statistics:		
Supervision	3,885.55	
Mortality statistics	85,256.21	
Life tables	8,417.35	
		97,559.11
Division of statistics of cities:		
Supervision	9,566.30	
Financial and general statistics	21,809.24	
Wealth, debt, and taxation, completion of	129,166.26	
Miscellaneous	533.53	
		161,075.33
Division of revision and results:		
Supervision	7,280.54	
Publications	6,355.04	
Dependent, defective, and delinquent classes	22,512.66	
Negroes in the United States	10,499.22	
Chinese and Japanese	233.34	
Official Register	126.66	
		47,007.46
Geographer's division: Salaries		19,010.15
Salaries of employees detailed to Department of Commerce		19,812.38
Grand total		1,490,747.46

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Title of appropriation.	Appropriation.	Expenditure.
Salaries, Bureau of the Census, 1915	$690,846.67	$674,249.93
Collecting statistics, Bureau of the Census, 1915	835,000.00	788,754.02
Tabulating machines, Bureau of the Census, 1915	12,000.00	11,876.58
Purchase of books of reference and periodicals, Bureau of the Census, 1915	500.00	500.00
Printing and binding [a]	122,302.82	[b] 122,302.82
Contingent expenses [a]	15,366.93	15,366.93
Total	1,676,016.42	[b] 1,613,050.28

[a] Paid from appropriation for Department of Commerce; no separate appropriation for Bureau of the Census.

[b] The item for printing and binding has not been distributed by divisions. The total of expenditures shown in this column therefore exceeds the grand total shown on the preceding page by $122,302.82.

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REPORT

OF THE

COMMISSIONER OF FISHERIES

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REPORT

OF THE

COMMISSIONER OF FISHERIES.

DEPARTMENT OF COMMERCE,
BUREAU OF FISHERIES,
Washington, October 11, 1915.

SIR: There is submitted herewith a report giving an outline review of the operations of the Bureau of Fisheries during the fiscal year ended June 30, 1915.

PROPAGATION AND DISTRIBUTION OF FOOD FISHES.

REVIEW OF THE OPERATIONS.

The scope and magnitude of the Bureau's operations in relation to the propagation and distribution of food and game fishes, and the bearing of this work on the maintenance of the fishery resources of the nation, are indicated by the following table, which shows an output of 4,288,757,800 fish and ova, an increase of 241,000,000 over the preceding year.

The increased output was accompanied by a diminished unit cost of production and a very noteworthy increase in the number of fish reared to the fingerling and yearling stages. As improved facilities are gradually provided at the various stations, in accordance with the established policy of the Bureau, the rearing of certain kinds of fishes will be further and further extended, and the effectiveness of the fish-cultural work will thus be annually augmented. In 1915 the fish distributed as fingerlings, yearlings, and adults numbered over 58,000,000, an increase of more than 150 per cent over 1914, made up largely of salmons, trouts, and basses.

SUMMARY, BY SPECIES, OF THE DISTRIBUTION OF FISH AND OVA DURING THE FISCAL YEAR 1915.

Species.	Eggs.	Fry.	Fingerlings, yearlings, and adults.	Total.
Catfishes			1,665,793	1,665,793
Carp			644,411	644,411
Yellow sucker			200	200
Buffalofish			114,849	114,849
Fresh-water drum			65	65
Shad		46,009,595		46,009,595
Alewife		4,851,000		4,851,000
Whitefish	98,900,000	405,400,000		504,300,000
Lake herring		92,350,000		92,350,000

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SUMMARY, BY SPECIES, OF THE DISTRIBUTION OF FISH AND OVA, ETC.—Continued.

Species.	Eggs.	Fry.	Fingerlings, yearlings, and adults.	Total.
Silver salmon	1,948,280	21,204,230	2,756,062	25,908,572
Chinook salmon	34,466,723	44,554,892	16,741,450	95,763,065
Blueback salmon	3,155,000	43,776,741	8,666,255	55,597,996
Humpback salmon		11,758,500	479,037	12,237,537
Dog salmon		35,504,707		35,504,707
Steelhead trout	634,000	2,259,113	3,244,660	6,137,773
Rainbow trout	2,022,990	568,930	2,144,875	4,736,795
Atlantic salmon		1,804,313		1,804,313
Landlocked salmon	291,000	310,042	140,015	741,057
Scotch sea trout		58,430		58,430
Blackspotted trout	3,435,000	1,939,250	4,784,067	10,158,317
Loch Leven trout			48,000	48,000
Lake trout	12,850,000	35,294,723	3,093,745	51,238,468
Brook trout	507,150	5,700,263	6,965,167	13,172,580
Smelt	14,500,000	6,900,000		21,400,000
Grayling	350,000	1,873,000		2,223,000
Crappies			1,800,900	1,800,900
Rock bass			414,078	414,078
Smallmouth black bass		653,170	81,177	734,347
Largemouth black bass		758,300	1,431,850	2,190,150
Sunfishes		135,000	2,799,766	2,934,766
Pike and pickerel			87,846	87,846
Pike perch	326,350,000	282,820,000	383	609,170,383
Yellow perch	19,000,000	195,267,000	104,287	214,371,287
Striped bass		8,594,500		8,594,500
White perch	17,850,000	161,980,000		179,830,000
White bass			2,825	2,825
Yellow bass			420	420
Cod		260,133,000		260,133,000
Pollock		500,730,000		500,730,000
Haddock		26,814,000		26,814,000
Flounder		1,294,156,000		1,294,156,000
Mackerel		4,847,000		4,847,000
Tautog		606,000		606,000
Lobster		194,670,000	3,779	194,673,779
Total	536,260,143	3,694,281,699	58,215,962	4,288,757,804

No material changes were made in the methods heretofore employed; but through the acquisition of additional knowledge of the conditions governing practical fish culture and the attainment of greater proficiency, the Bureau was enabled to further develop the resources at its command, extending its activities into new fields contiguous to those already covered, and materially increasing its output over that of any previous year in its history. In attaining these results the funds available were not greater than those of 1914.

While there were slight decreases in the output of some of the fishes propagated, there were substantial gains in some of the more important species. A partial list of the latter class includes catfishes, whitefish, lake herring, silver salmon, chinook salmon, dog salmon, steelhead trout, rainbow trout, blackspotted trout, brook trout, crappies, black basses, sunfishes, pike perch, and yellow perch.

The output of the hatcheries devoted to the marine species of the North Atlantic coast, the commercial fishes of the Great Lakes, and the migratory food fishes of the Atlantic coast streams, which is always far in excess of the rearing capacity of these stations, was deposited on the natural spawning grounds within a few days after the hatching of the eggs. On the other hand, a considerable percentage of the salmons, trouts, black basses, crappies, sunfishes, and catfishes was reared to the fingerling or yearling stage before being distributed.

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The comprehensive scope of the fish-cultural work is shown by the fact that egg collections and hatching operations were conducted in 32 States and Alaska, while the distributions reached every State and Territory. The larger part of the output is planted in public waters on the initiative of the Bureau or on the recommendation of the State authorities, but the fishes adapted for ponds, smaller lakes, and the minor interior waters are mostly consigned on individual applications. The distribution of this latter class of fishes involved railroad travel aggregating 637,716 miles, of which 146,544 miles were covered by the special cars of the Bureau and 491,172 miles by detached messengers. About 80 per cent of the railroad transportation was paid for at varying rates, but 116,665 miles of free transportation were afforded by certain companies which appreciated the advantage accruing from the stocking of waters along their lines.

Recognition of the value of the Bureau's efforts in maintaining and increasing the fish supply of public and private waters is evidenced by the widespread interest manifested in its work by people in all sections of the country. The feasibility of cultivating fish in ponds on farms is attracting general interest, and of the many thousand applications for food and game fishes received during the year fully 80 per cent called for species suitable for stocking artificially constructed ponds and natural inland waters of small area.

Notwithstanding the fact that the Bureau is annually increasing its facilities, it experiences difficulty in meeting the constantly growing demand for fish to stock the public and private waters of the interior. This applies with special force to the black basses, crappies, sunfishes, catfishes, and other fishes adapted to culture in ponds, most of which are not susceptible of propagation by the artificial means employed with the salmons and trouts, but must be produced through the natural reproduction of brood fish carried in ponds.

The expansion of the Bureau's fish-cultural operations is necessarily limited by the funds provided and the number of experienced men available for the work. Large unproductive and potentially valuable fields for the enlargement of the salmon operations exist in Alaska and the Pacific States; more extensive fish-cultural work is demanded for the maintenance of the commercial fisheries of the Great Lakes, while there are practically unlimited areas in the Rocky Mountains, Middle, Western, and Southern States which would prove of inestimable value for fish culture were funds available for developing them.

HATCHERIES OPERATED.

During the fiscal year 1915 fish-cultural operations were conducted at 50 permanent hatcheries and at 76 subhatcheries, auxiliaries, and egg-collecting stations. The stations which have been undergoing construction at Louisville, Ky., and Orangeburg, S. C., are now nearly completed, and some fish-cultural work was accomplished at each during the year. One new station has been added to the service by the partial completion of the hatchery at Saratoga, Wyo., which will soon be in condition for the propagation of fish on a small scale. A site has been selected for a fish-cultural station at Springville, Utah, and an appropriation of $50,000 has been provided by Congress to cover

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the purchase of the necessary land and water rights, construction of buildings, and equipment. A topographical survey of the land will be made, and the construction of the station will begin as soon as the validity of the title to the property can be passed upon by the Department of Justice. A new field station for the prosecution of the Pacific salmon work was located during the year on Quiniault Lake, in the State of Washington, and judging from the results of the initial year's operations the site will be desirable for the establishment of a permanent hatchery.

The major hatcheries operated in 1915 may be conveniently classified as follows. Included in this statement are some leased and other complete hatcheries which are operated as auxiliaries to other stations.

Location and character of operations.	Number.
Atlantic rivers, for salmons, shad, striped bass, yellow perch, and white perch	5
Pacific rivers, for salmons and steelhead trout	12
Great Lakes, for whitefish, cisco, lake trout, and pike perch	5
Interior waters, for basses, sunfishes, crappies, trouts, etc	25
Atlantic coast, for cod, haddock, pollock, flounder, and lobster	3
Total	50

Following is a list of the stations, with the subsidiary stations thereunder, the period of operation, and the species handled. The main stations, arranged alphabetically, are those for which a permanent personnel is provided by law, or which are operated more or less independently. In some cases, however, the subsidiary or auxiliary stations are completely equipped, semi-independent, and quite as important as the head station to which, for administrative purposes, they are attached.

FISH-CULTURAL STATIONS OPERATED DURING THE FISCAL YEAR 1915.

Designation.	Period of operation.	Species handled.
Afognak, Alaska	Entire year	Blueback and humpback salmons.
Uganik Bay, Alaska	June	Blueback salmon.
Seal Harbor, Alaska	June-October	Do.
Baird, Cal	Entire year	Chinook and silver salmons.
Battle Creek, Cal	December-April	Do.
Hornbrook, Cal	December-May	Chinook and silver salmons and rainbow trout.
Mill Creek, Cal	November-March	Chinook salmon.
Baker Lake, Wash	Entire year	Blueback, chinook, and silver salmons.
Birdsview, Wash	....do	Blueback, chinook, dog, humpback, and silver salmons and steelhead trout.
Quiniault, Wash	....do	Blueback, chinook, and silver salmons and steelhead trout.
Brinnon, Wash	December-March	Dog and silver salmons.
Darrington, Wash	Entire year	Do.
Day Creek, Wash	....do	Chinook, dog, and silver salmons.
Duckabush, Wash	....do	Dog, humpback, and silver salmons.
Hlabott Creek, Wash	....do	Chinook, dog, and silver salmons and steelhead trout.
Quilcene, Wash	....do	Dog, humpback, and silver salmons and steelhead trout.
Sultan, Wash	....do	Chinook and silver salmons and steelhead trout.
Battery, Md	March-May	Shad, alewife, white and yellow perches.
Boothbay Harbor, Me	Entire year	Cod, flounder, haddock, and lobster.
Portland, Me	July-October; May-June	Lobster.

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FISH-CULTURAL STATIONS OPERATED DURING THE FISCAL YEAR 1915—Continued.

Designation.	Period of operation.	Species handled.
Bozeman, Mont	Entire year	Blackspotted, brook, lake, rainbow, and steelhead trouts; grayling; and landlocked salmon.
O'Dell Creek, Mont	Mar. 22–May 4	Grayling.
Meadow Creek, Mont	Mar. 22–May 1	Grayling and rainbow trout.
Yellowstone Park, Wyo	July–September; May–June	Blackspotted trout.
Clear Creek, Wyo	July 1–21; June	Do.
Columbine Creek, Wyo	July 1–16; June 14–30	Do.
Cub Creek, Wyo	July 1–21; June 4–30	Do.
Lake Camp, Wyo	July 1–Sept. 10; May 12–June 30	Do.
Pelican Creek, Wyo	July 1–16; May 21–June 30	Do.
Bryans Point, Md	March–May	Shad and yellow perch.
Cape Vincent, N. Y	Entire year	Brook and lake trouts, lake herring, pike perch, and whitefish.
Three Mile Bay, N. Y	November	Lake herring.
Central Station, Washington, D. C.	Entire year	Shad, pike perch, and yellow perch.
Clackamas, Oreg	do	Blackspotted, brook, lake, rainbow, and steelhead trouts; Chinook and silver salmons.
Applegate, Oreg	do	Chinook and silver salmons and steelhead trout.
Big White Salmon, Wash	do	Chinook salmon.
Illinois River, Oreg	March	Chinook and silver salmons.
Little White Salmon, Wash	Entire year	Chinook salmon.
Rogue River, Oreg	do	Blackspotted and steelhead trouts and chinook salmon.
Willamette Oreg	July–June	Shad.
Cold Springs, Ga	Entire year	Black bass, catfish, and sunfish.
Harris Pond, Ga	do	Catfish and sunfish.
Craig Brook, Me	do	Atlantic and humpback salmons, brook and Scotch sea trouts.
Upper Penobscot, Me	January and June	Atlantic salmon.
Duluth, Minn	Entire year	Brook, lake, and steelhead trouts; lake herring; landlocked salmon; pike perch; and whitefish.
Grand Marais, Minn	Oct. 1–Dec. 3	Lake herring and lake trout.
Isle Royal, Mich	Sept. 23–Nov. 21	Lake trout and whitefish.
Keweenaw Point, Mich	Oct. 4–Nov. 21	Lake trout.
Marquette, Mich	Oct. 14–Dec. 2	Lake trout and lake herring.
Munising, Mich	Oct. 14–Nov. 10	Lake trout.
Ontonagon, Mich	Oct. 17–Nov. 9	Do.
Edenton, N. C	Entire year	Black bass, shad, sunfish, and white perch.
Weldon, N. C	April–May	Striped bass.
Erwin, Tenn	Entire year	Brook and rainbow trouts, large and smallmouth black basses, rock bass, carp, sunfish, and sucker.
Gloucester, Mass	do	Cod, flatfish, haddock, lobster, mackerel, and pollock.
Green Lake, Me	do	Brook and lake trouts, humpback salmon, landlocked salmon, and smelt.
Grand Lake Stream, Me	do	Landlocked salmon.
Homer, Minn	do	Black bass, buffalofish, carp, catfish, crappie, pike, pike perch, smallmouth black bass, and sunfish, white bass, and yellow perch.
La Crosse, Wis	do	Black bass, buffalofish, carp, catfish, crappie, pike, pike perch, sunfish, yellow perch, brook and rainbow trouts.
Leadville, Colo	do	Blackspotted, brook, and rainbow trouts and grayling.
Antero Reservoir, Colo	Apr. 11–May 22	Rainbow trout.
Cheesman Lake, Colo	Apr. 7–May 15	Do.
Edith Lake, Colo	Oct. 16–Nov. 9	Brook trout.
Engelbrechts Lake, Colo	Oct. 9–Nov. 21	Do.
Musgrove Lakes, Colo	Oct. 23–Nov. 20	Do.
Smiths Ponds, Colo	Oct. 28–Nov. 25	Do.
Northfield Lakes, Colo	Oct. 18–Nov. 16	Do.
Stonewall Lake, Colo	Apr. 15–May 15	Rainbow trout.
Turquoise Lake, Colo	Oct. 27–Nov. 17	Brook trout.
Wellington Lake, Colo	Oct. 15–Nov. 10	Do.
Woodland Park Lakes, Colo	Oct. 18–Nov. 16	Do.
Louisville, Ky	Entire year	Black bass and sunfish.
Mammoth Spring, Ark	do	Large and smallmouth black basses, crappie, rock bass, and sunfish.
Friars Point, Miss	July–December	Black bass, catfish, crappie, rock bass, and sunfish.

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FISH-CULTURAL STATIONS OPERATED DURING THE FISCAL YEAR 1915—Continued.

Designation.	Period of operation.	Species handled.
Manchester, Iowa	.....	Brook, lake, and rainbow trouts, pike perch, rock bass, large and smallmouth black basses, and sunfish.
Bellevue, Iowa	August–December	Black bass, buffalofish, carp, catfish, crappie, drum, pike, sunfish, white bass, yellow bass, and yellow perch.
North McGregor, Iowa	.....do.....	Black bass, buffalofish, carp, catfish, crappie, pike, sunfish, white bass, and yellow perch.
Nashua, N. H	Entire year	Brook and rainbow trouts, landlocked salmon, and smallmouth black bass.
Neosho, Mo	.....do.....	Brook and rainbow trouts, black bass, crappie, rock bass, smallmouth black bass, and sunfish.
Northville, Mich	.....do.....	Brook, lake, and rainbow trouts; grayling; landlocked salmon; smallmouth black bass.
Alpena, Mich	April–May	Lake trout and whitefish.
Bay City, Mich	Apr. 17–28	Pike perch.
Bay Port, Mich	Nov. 9–21	Whitefish.
Belle Isle, Mich	Oct. 25–Dec. 8	Do.
Charity Island, Mich	Oct. 14–Dec. 2	Do.
Charlevoix, Mich	March–April	Lake trout and whitefish.
Detour, Mich	Oct. 18–Nov. 19	Lake trout.
Detroit, Mich	April–May	Pike perch and whitefish.
Fairport, Mich	Oct. 29–Nov. 16	Lake trout.
Frankfort, Mich	Nov. 3–14	Do.
Manistique, Mich	Oct. 29–Nov. 25	Do.
Naubinway, Mich	Nov. 16–Dec. 12	Whitefish.
St. James, Mich	Oct. 29–Dec. 18	Lake trout and whitefish.
Sault Ste. Marie, Mich	April–May	Do.
Orangeburg, S. C	Entire year	Black bass.
Put-in Bay, Ohio	.....do.....	Lake herring, lake trout, pike perch, and whitefish.
Cleveland, Ohio	Nov. 29–Dec. 6	Lake herring.
Kellys Island, Ohio	Nov. 14–Dec. 8	Whitefish.
Middle Bass, Ohio	Nov. 14–Dec. 6	Do.
Monroe, Mich	Nov. 5–Dec. 10	Do.
North Bass, Ohio	Apr. 15–27	Pike perch and whitefish.
	Nov. 10–Dec. 8	Do.
Port Clinton, Ohio	Apr. 9–30	Do.
	Nov. 14–Dec. 9	Do.
Toledo, Ohio	Apr. 8–28	Do.
	Nov. 14–Dec. 9	Do.
Quincy, Ill	Entire year	Black bass, buffalofish, carp, crappie, catfish, pike perch, rock bass, strawberry bass, sunfish, yellow bass, and yellow perch.
St. Johnsbury, Vt	.....do.....	Brook, lake, rainbow, and steelhead trouts, landlocked salmon, smallmouth black bass, and yellow perch.
Darling Pond, Vt	July 21–Dec. 29	Brook trout.
Holden, Vt	Entire year	Brook, lake, and steelhead trouts, and landlocked salmon.
Lake Mitchell, Vt	July 1–Dec. 18	Brook trout.
Lake Tarlton, N. H	June 15–30	Smallmouth black bass.
Orleans, Vt	Apr. 15–June 30	Steelhead trout.
Speedwell Pond, Vt	Oct. 21–Nov. 3	Brook trout.
Swanton, Vt	April–May	Pike perch and yellow perch.
San Marcos, Tex	Entire year	Black bass, catfish, crappie, rock bass, and sunfish.
Spearfish, S. Dak	.....do.....	Blackspotted, brook, lake, Loch Leven, and rainbow trouts.
La Plant Lake, S. Dak	Oct. 15–Jan. 15	Brook and Loch Leven trouts.
Schmidt Lakes, S. Dak	Oct. 20–Dec. 25	Brook trout.
Tupelo, Miss	Entire year	Black bass and sunfish.
White Sulphur Springs, W. Va	.....do.....	Large and smallmouth black basses, brook and rainbow trouts.
Woods Hole, Mass	.....do.....	Cod, flatfish, and mackerel.
Plymouth, Mass	Nov. 23–Jan. 11	Cod.
Waquoit, Mass	Jan. 1–Apr. 15	Flatfish.
Wickford, R. I	Feb. 26–Apr. 5	Do.
Wytheville, Va	Entire year	Brook and rainbow trouts; large and smallmouth black basses, pike perch; rock bass; and sunfish.
Yes Bay, Alaska	.....do.....	Blueback salmon.
Ketchikan Creek, Alaska	September–October	Humpback salmon.

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FISH-CULTURAL RELATIONS WITH THE STATES AND WITH FOREIGN COUNTRIES.

The Bureau has continued and extended its cooperative relations with the State fishery authorities, and in 1915 allotted large numbers of eggs to be hatched under State auspices and considerable numbers of young fish for planting in local waters. The States which requested this kind of aid from the Bureau number 27 and include nearly all that are engaged in practical fish culture. A list of the States, with the allotments to each, is shown in the following table:

ALLOTMENT OF FISH AND EGGS TO STATE FISH COMMISSIONS IN THE FISCAL YEAR 1915.

State and species.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
California:			
Brook trout	100,000		
Chinook salmon	34,301,073		
Rainbow trout	497,240		
Silver salmon	1,913,280		
Colorado:			
Blackspotted trout	200,000		200,000
Brook trout			50,000
Delaware:			
Crappie			600
Sunfish			400
Idaho: Blackspotted trout	250,000		
Illinois:			
Black bass			4,450
Brook trout			525
Catfish			11,000
Crappie			7,400
Pike perch	15,000,000		
Sunfish			13,500
Yellow perch			3,300
Indiana: Pike perch	3,000,000		
Iowa:			
Black bass			3,240
Crappie			5,000
Pike perch	8,000,000		
Sunfish			5,000
Maine:			
Brook trout	100,000		
Lake trout	50,000		
Landlocked salmon	100,000		
Smelt		5,000,000	
Massachusetts:			
Landlocked salmon	15,000		
Pike perch	15,000,000		
Rainbow trout	216,000		
White perch	13,000,000		
Yellow perch	10,000,000		
Michigan:			
Lake trout	3,000,000		
Landlocked salmon	15,000		
Pike perch	26,400,000		
Minnesota:			
Lake trout		100,000	
Steelhead trout	100,000		
Montana:			
Blackspotted trout	400,000		
Lake trout			5,000
Whitefish	1,000,000		
Nebraska:			
Pike perch	2,000,000		
Rainbow trout			20,000
Nevada:			
Brook trout	50,000		
Rainbow trout	100,000		
New Hampshire:			
Brook trout	30,000		
Landlocked salmon	30,000		

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ALLOTMENT OF FISH AND EGGS TO STATE FISH COMMISSIONS, ETC.—Continued.

State and species.	Eggs.	Fry.	Fingerlings, yearlings, and adults.
New Jersey:			
Black bass			5,125
Crappie			1,050
Landlocked salmon	25,000		
Rainbow trout	100,000		
Steelhead trout	100,000		
Sunfish			2,000
White perch	4,850,000		
Yellow perch	8,000,000		
New Mexico: Blackspotted trout	100,000		
New York:			
Lake trout	100,000		
Landlocked salmon	20,000		
North Dakota:			
Black bass			900
Crappie			600
Pike perch	5,000,000		
Rainbow trout	40,000		
Ohio:			
Pike perch	247,450,000		
Whitefish	66,840,000		
Oregon:			
Blackspotted trout	500,000		51,100
Blueback salmon	3,100,000		
Rainbow trout	200,000		
Steelhead trout			27,379
Pennsylvania:			
Lake trout	100,000		
Whitefish	24,560,000		
Utah:			
Blackspotted trout	100,000		
Rainbow trout	100,000		
Vermont:			
Chinook salmon	12,000		
Lake trout	200,000		
Landlocked salmon	30,000		
Smelt	5,000,000		
Steelhead trout	200,000		
Washington:			
Blackspotted trout	400,000		
Blueback salmon	50,000		
Rainbow trout	75,000		
Steelhead trout	100,000		
Wisconsin:			
Lake trout	9,200,000		
Whitefish	6,000,000		
Wyoming:			
Blackspotted trout	700,000		
Brook trout	75,000		
Grayling	50,000		
Lake trout	50,000		
Rainbow trout	75,000		
Steelhead trout	100,000		
Total	518,469,593	5,100,000	417,569

In pursuance of the policy adopted in 1914, the Bureau is referring to the proper State officials all applications for fish not native to a given State. Moreover, it refuses to entertain applications for such fishes as the black basses, crappies, sunfishes, perches, and pikes for deposit in any of the Pacific coast lakes or streams which are inhabited by salmon or trout, or are connected directly or indirectly with trout or salmon waters. This policy, which commends itself to all who have the welfare of the fisheries at heart, has received the indorsement of the fishery authorities, the congressional delegations, and the commercial interests of the States concerned.

In compliance with official requests received from Porto Rico, Cuba, India, and Japan, consignments of rainbow-trout eggs and of various species of pond fishes were made as follows:

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SHIPMENTS OF FISH AND EGGS TO INSULAR POSSESSIONS AND FOREIGN COUNTRIES, FISCAL YEAR 1915.

Country and species.	Eggs.	Fingerlings, yearlings, and adults.
Porto Rico:		
Black bass		600
Catfish		600
Rock bass		1,200
Sunfish		600
Cuba: Black bass		1,000
India: Rainbow trout	40,000	
Japan: Rainbow trout	400,000	
Total	440,000	4,000

PROPAGATION OF THE PACIFIC SALMONS.

The propagation of the Pacific salmons is the most extensive and important branch of the fish-cultural work, and the expense incurred consumes about one-third of the total appropriation available for fish culture.

Increased facilities are annually being provided at all the Pacific coast stations for the rearing of salmon to the fingerling stage before liberating them, and it is the policy of the Bureau to reduce the output of fry and increase the distribution of fingerling fish.

The salted flesh of the salmon captured for propagating purposes having been found to be a wholesome and economical food for young salmon, tons of this material were last year preserved and stored for use in connection with the rearing operations at the various Pacific coast stations. Sun-dried and mild-cured salmon have also been experimented with but are found to be inferior to the salted article. The salted salmon is soaked for a few days before using and is then placed in a hand press, which removes salt and moisture, and leaves the meat soft and flaky. Finally the material is run through a meat chopper, which reduces it to a pulp. As the young salmon take this food readily and thrive upon it, its use will go far toward solving one of the main obstacles in the way of extensive rearing operations, namely, the great cost of food.

The genuine progress that is being made in this vitally important matter is shown by the fact that in 1914 the number of reared salmon liberated was 5,764,000, while in 1915 the number was 28,642,000, of which nearly 90 per cent were chinook and blueback salmons.

Although three years have elapsed since the eruption of Mount Katmai in June, 1912, the lakes and streams on Afognak Island, Alaska, still contain large deposits of volcanic ash and sand, which greatly interfered with fish-cultural operations during the summer and fall of 1914. These deposits, constantly drifting with the currents, formed shifting bars at the mouths of the rivers, preventing the ascent of salmon to the spawning grounds or diverting their movements to other waters where conditions were more favorable. During the summer months, when the salmon runs were on and high water prevailed, the tributary streams became so badly affected with volcanic ash that days and sometimes weeks were required for the water to clear to any appreciable extent after the floods subsided.

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The first blueback salmon made their appearance in the bay early in June in fairly large numbers, but severe storms occurring during the middle of the month caused the water to become thick with volcanic ash; this drove the fish to sea and delayed their movements until the following month, when they appeared in Litnik and tributary streams in greatly reduced numbers. Despite obstacles of this character encountered during the operating season, the work at the Afognak station was satisfactory, the output for the year 1915 amounting to 942,250 fry and 5,444,830 fingerling blueback salmon, and 224,000 fry and 119,480 fingerling humpback salmon. Of the 14,074,000 humpback salmon eggs collected 12,500,000 were transferred to the Washington stations for final development.

The field station established at Eagle Harbor, Kodiak Island, in 1914 proved a failure and was abandoned, but on account of improved conditions affecting the run of salmon in contiguous waters the Uganik field station was operated during the year and produced 2,500,000 eggs. Late in June, 1914, after careful investigations had been made, a field station was established at Seal Bay, on the northeast coast of Afognak Island, where there is a prospect of making large egg collections.

Improvements at the Afognak station during the year consisted in the extension of the tramway to a point on Litnik Lake, where a small wharf was constructed to facilitate the landing of launches and small boats, and the construction of a battery of 12 rearing ponds supplied with water from Ahuyon Creek.

Owing to a decline in the run of blueback salmon in the waters tributary to Yes Bay, Alaska, there was a material decrease in the egg collections and a corresponding reduction in the output of fish from the Yes Bay hatchery, which was smaller than in any year since its establishment. While unfavorable weather conditions and low water occurring during the spawning season influenced the movement of the fish to some extent, it is believed that the failure of the usual large schools of fish to reach their accustomed spawning grounds during the summer and fall of 1914 was due primarily to the operation of more traps, in which a large percentage of the salmon entering the bay are captured before the fish can reach the headwaters. The spawning season of the blueback salmon extended from September 3 to September 30. Fishing operations were conducted every day by the station crew during this period, and while no fish escaped through the racks and few spawned in the river, the total yield of eggs numbered only 41,300,000, as compared with 49,050,000 in 1914, 66,125,000 in 1913, and 72,000,000 in 1912.

The same conditions prevailed in Ketchikan Creek, where a field station had been fitted up at considerable expense for conducting humpback salmon operations. After adequate provisions had been made to intercept the spawning fish the usual large run of humpback salmon failed to appear, and consequently no eggs were secured.

On September 1 a temporary field station was established at Quadra Bay, and 2,600,000 eggs were obtained and transferred to the Ketchikan station for development. Large numbers of salmon were seen in Quadra Bay, but storms and high water occurring during the operating season, and lack of proper equipment to cope with the situation, necessitated the abandonment of the work before all of the fish could be overhauled.

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As a result of the year's work 32,020,000 fry and 3,175,000 fingerling blueback salmon were distributed in local waters, and 3,000,000 eyed eggs of that species were donated to the Oregon Fish Commission. All of the humpback salmon eggs after being eyed were transferred to the Washington stations.

The completion of the electric power house and the reconstruction of the bunk house, which was destroyed by fire in 1914, were the features of improvement at this station.

Substantial gains were made in the output of all of the more important species handled at the stations in the Pacific States, and the work as a whole was attended with gratifying results.

At the Washington stations the operations for the year were very successful, the output far exceeding that of any previous year. The total egg collections of all species numbered 73,145,800, which produced 65,408,680 fry and fingerling fish, exceeding the total distributions of the previous year by 16,500,000. Of the total egg collections, 19,565,000, or nearly 27 per cent, were secured at the field station located on the Dusewallips River, a tributary of Hood Canal, 4½ miles from the Duckabush station, which was operated for the first time in 1912. The work of the station is addressed to the propagation of the silver and dog salmons and the steelhead trout.

While there was a slight falling off in the output of steelhead trout, the distribution of blueback salmon at the Baker Lake station, owing to the effectiveness of the new trap installed at the outlet of Baker Lake, was in excess of 7,200,000. There was also a large gain made with the silver salmon, while the output of dog salmon from the Duckabush, Quilcene, and Brinnon stations, on Hood Canal, was 30,705,500 or three times greater than in 1914.

The work of reconstructing the hatchery building and barn at the Baker Lake station, which were destroyed by fire in May, 1914, was undertaken during the spring of 1915, and the buildings are now nearing completion. Practically all of the fish-cultural operations at this station during the year were conducted in an improvised hatchery hastily constructed by the station employees with the material available.

At the Duckabush station the shore line of the river opposite the rearing pond system was protected by crib work and rack, to prevent the washing of the banks and inundation of the ponds during flood periods.

At the Birdsview station the old hatchery building was moved to a location across Grandy Creek, a two-room addition was made to the mess house, and a two-room cottage was constructed on the property recently acquired opposite the superintendent's residence. Extensive repairs were made to the intake dam on Grandy Creek, from which the water supply is obtained.

The results of the operations conducted at the field station located during the fall of 1914 in the Quiniault Indian Reservation were very gratifying, and from the experience thus far gained it is believed this will prove a very valuable field for the establishment of a permanent station, blueback, chinook, and silver salmons and steelhead trout being found in the Quiniault Lake and River in plentiful numbers. While the operations were conducted in an experimental way, with crude apparatus and limited facilities, the output of the station

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amounted to 3,558,591 blueback salmon, 19,913 chinook salmon, 198,966 silver salmon, and 10,598 steelhead trout. An outside battery of troughs with a capacity for 20,000,000 eggs was constructed and supplied with water through a flume from a spring-fed stream in the vicinity. A small three-room cottage with unfinished interior was provided for the foreman in charge, and at the close of the year preparations were being made for the extension of the hatching facilities.

Increased efforts and generally favorable climatic conditions prevailing in Oregon resulted in substantial gains in the output from the nine stations operated in that State. The total egg collections of all species numbered 70,392,674, while the distributions of chinook salmon, silver salmon, and steelhead trout exceeded that of last year. An enormous run of chinook salmon in Columbia River, which characterized the season of 1913, again made its appearance in the river in the summer and fall of 1914 at the stations on the Big White Salmon and Little White Salmon Rivers, and 47,695,000 eggs were obtained, or 3,466,000 in excess of last year's take at the same points. The handling of this large number of eggs necessitated the installation of additional hatching equipment and the shipment of large consignments of eggs to other stations for development. Eggs of the spring run chinook salmon to the number of 3,718,000, which were donated by the Oregon State Fish Commission, were hatched at the Clackamas station, and the fry, reared to the fingerling stage, were planted in Clackamas River, with a view of improving the spring run of salmon in that basin. To facilitate the rearing of salmon, a battery of seven cement ponds were constructed at the Clackamas station.

Floods occcurring during the operating season destroyed the racks at the Upper Clackamas and Rogue River stations, curtailing the output of chinook salmon and steelhead trout in those fields. Gains were made in the distribution of silver salmon where this species was propagated.

While low water and unfavorable weather conditions somewhat interfered with the movements of the fish, there was a large increase in the egg collections at all of the California stations, amounting to 38 per cent in the chinook salmon, 29 per cent in silver salmon, and 400 per cent in rainbow trout. The total collections of all species were 57,807,200, more than double those of the previous year, while the distributions of eyed eggs, fry and fingerling fish were correspondingly large. In addition to 5,000,000 chinook salmon fry, 9,053,635 fingerling fish of this species were liberated in local waters, or more than double the number produced last year.

The largest gains were made at the Battle Creek and Mill Creek stations, where the aggregate egg collections numbered considerably over 25,000,000. The summer and fall run of salmon in the McCloud River was light, although the output of the Baird station slightly exceeded that of last year. At the Hornbrook station the take of rainbow trout eggs exceeded expectations, being more than 2,600,000. As in former years, the egg collections exceeded the hatching capacity of the Bureau's stations and the surplus was turned over to the State hatcheries for development.

In order to facilitate the handling of spawning salmon and improve the water supply, the Hornbrook hatchery was moved to the

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north side of Klamath River, and an undershot water wheel 28 feet in diameter, with 24 buckets, was installed on the river bank 5,350 feet above the hatchery, the water being conveyed thereto through open flumes and ditches.

FISH PROPAGATION ON THE GREAT LAKES.

At the Great Lakes hatcheries the results of the work with the commercial fishes were in general satisfactory. While storms and sudden ice formation hampered fishing operations during the spawning season, the losses in some fields were in most instances compensated for by unusual success in others, and the final outcome of the collecting season was an aggregate of 1,843,493,540 eggs of all species handled as compared with 1,634,591,880 during the corresponding season of 1914. Of this total 132,000,000 represented eggs of the cisco, or lake herring, the bulk of which were secured in Lakes Ontario and Superior, where the propagation of this desirable fish was undertaken by the Bureau for the first time in the fall of 1914. The egg collections of only one species—the common whitefish—fell behind those of the previous year, the total shortage in this instance amounting to about 42,000,000. The take of lake-trout eggs, on the other hand, was over 8,000,000 in excess of that in 1914, and there was a small gain in the collection of pike-perch eggs over last year.

The lake-trout work in Lake Superior opened on September 24, and during the spawning season, which lasted 59 days, 16,247,000 eggs of good quality were secured and transferred to the Duluth hatchery. This stock was supplemented later by the receipt of 6,932,000 eggs from Lake Michigan fields, but for some reason the latter consignment was of exceptionally poor quality. On reaching the eyed stage, 500,000 eggs were shipped on assignment. The remainder produced 14,715,000 young fish, which were distributed during the spring on the spawning grounds where the brood fish were secured.

The initial attempt to propagate lake herring at the Duluth station met with a fair measure of success so far as egg collections were concerned, but the quality of the eggs was impaired by unfavorable weather conditions during the spawning season and by the rough handling to which the fish were subjected on the fishing tugs prior to their delivery to the Bureau's spawn takers. From the 32,000,000 eggs laid down in the hatchery, there were produced only 9,750,000 fry, which were returned in April to the spawning grounds in Lake Superior.

During the season there were planted in sheltered waters of Lake Superior 16,400,000 whitefish fry, which originated from a consignment of 25,000,000 eggs transferred to Duluth from Lake Erie fields and from a collection of 810,000 eggs made near Isle Royal, Mich., in the course of the lake-trout operations.

During April two lots of pike-perch eggs—one of 12,000,000 furnished by the Minnesota Fish Commission, and one of 20,000,000 green eggs transferred from the Bureau's Detroit station—were received and hatched at Duluth. The former consignment yielded 4,000,000 healthy fry, but the remaining eggs were of such poor quality that only 3,450,000 fry resulted from them. All of the pike-perch

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fry, as well as 426,000 young brook trout derived from eggs purchased from commercial fish-culturists, 48,500 steelhead trout fry, and 23,500 landlocked salmon fry, were distributed to applicants in Minnesota and surrounding States. The eggs of the two last-named species were transferred to Duluth from other stations of the Bureau.

Lake-trout eggs for stocking the Michigan hatcheries were obtained as usual from Lakes Michigan and Huron, the spawn-taking season extending from October 18 to November 25. Field stations established at the customary points were manned so far as practicable by permanent employees, and experienced men were temporarily employed to assist in gathering spawn on the large fishing tugs, while arrangements were made with fishermen operating gasoline boats to take the eggs themselves. The weather throughout the season was stormy and at times the wind was of such velocity that for periods of two to five days it was not possible to attend the nets. Notwithstanding this handicap the season was one of the most successful ever experienced, the aggregate egg collections being 66,424,000, nearly 14,000,000 in excess of the previous year. Of this stock 28,864,000 green and eyed eggs were used to fill applications; the remainder were incubated at the Charlevoix, Alpena, and Sault Ste. Marie hatcheries, and the fry were liberated in the immediate vicinity of these stations soon after hatching.

The gathering of whitefish spawn for the Michigan stations covered a period of two months, beginning October 14. Field stations for the purpose were located, as heretofore, in Detroit River, Saginaw Bay, and the upper part of Lake Michigan. Owing to unfavorable natural conditions, the work was only partially successful. Spawning fish were notably scarce everywhere, and especially was this true in the Saginaw Bay district, ordinarily accounted one of the most prolific sources for whitefish eggs. The work in this field was also hampered by violent winds and ice formation, which made it impossible for some of the fishermen to attend their nets during as long a period as nine days near the height of the season. The whole Saginaw Bay field is so much exposed that successful whitefish work is dependent almost entirely on weather conditions.

The former prolific fishing ground at Grassy Island, in Detroit River, which has been available for the Bureau's operations since 1899, has now been destroyed by the dredging operations of the Government for the opening of a deep waterway. At Belle Isle, the only remaining whitefish field in this river, fishing was conducted under the supervision of the State warden, who sold the stripped fish to defray the expense of his work.

The following table shows the field stations operated in Michigan waters, the period of operations, and the number of whitefish eggs secured at each:

Locality.	Season.	Number.
Belle Isle, Detroit River	Oct. 25–Dec. 8	27,340,000
Charity Island, Saginaw Bay	Oct. 14–Dec. 2	26,280,000
Bay Port, Saginaw Bay	Nov. 9–Nov. 21	180,000
Naubinway, Lake Michigan	Nov. 16–Dec. 2	10,680,000
St. James and Charlevoix, Lake Michigan	Dec. 1–Dec. 18	35,000,000
Total		99,480,000

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As the egg collections were not equal to the available hatching facilities, the shortage was made up by the transfer of 117,800,000 eggs to the Detroit hatchery from the collecting field in Lake Erie, near Monroe, Mich. An assignment of 6,000,000 was deducted from the stock on hand for shipment to the Wisconsin Fish Commission and 49,280,000 eggs failed to develop. On reaching the eyed stage the 162,000,000 constituting the remainder were subdivided, 70,000,000 being retained at Detroit, and the remainder forwarded to the auxiliary hatcheries in northern Michigan, to be hatched in connection with the lake-trout eggs elsewhere referred to.

Pike-perch egg collections in Michigan waters were confined to the field off Bay City, in Saginaw Bay, the work extending over the last half of April and yielding 102,600,000 eggs. Of these 20,000,000 were shipped green to the Duluth hatchery and 12,500,000 fry were hatched and planted in various waters in the State.

The whitefish propagation in Lake Erie was satisfactory. A scarcity of fish occurred in the Put-in Bay field, and there was a shortage in the catch at Monroe Piers, owing to the destruction of some of the fishermen's nets by floating fields of ice at the height of the spawning season. The take of eggs in all other fields in this lake was greater than ever before, and the yield from some of them was twice that of the preceding year. While the aggregate egg collections, amounting to 479,290,000, were nearly 10,000,000 less than in 1914, their quality was so good that there was a decided increase in the whitefish output of the Put-in Bay station. The superior quality of the eggs is attributed partly to the supervision of the operations of the commercial fishermen by the Michigan fish wardens, who were constantly on the grounds during the spawning season, and partly to a change in the method of handling unripe fish. Heretofore it has been customary to hold large numbers of immature whitefish in pens on the spawning grounds for the ripening of their eggs, and it has been noted that a considerable per cent of the fish so held became affected by a condition known as "plugging," whereby no eggs were secured from them. This year it was determined to place no fish in the pens until they were nearly ready to spawn, and the results of this change in method were clearly apparent, the eggs not only being of a finer grade but the average yield per fish being larger than under the old system. The output from the Put-in Bay station included shipments of green and eyed eggs to the number of 235,700,000 and the liberation of 209,000,000 vigorous fry in the waters of Lake Erie.

Incidental to the whitefish operations 6,930,000 lake herring eggs were taken and hatched, the output of fry numbering 3,400,000.

Notwithstanding the fairly good results obtained with the pike perch in Lake Erie, as regards both quality of eggs and number secured, the collecting period was the shortest every known in Lake Erie. Weather conditions in the early spring were all that could be desired, thus permitting of the installation of fishing and spawn-taking apparatus in advance of the season; and while brood fish appeared in plentiful numbers near the beginning of April, none in spawning condition were taken until the middle of the month. Between that time and the end of the season, which lasted 15 days, eggs to the number of 511,715,000 were taken, the majority being obtained

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in the Port Clinton and Toledo fields. Of these collections 305,450,000 green and eyed eggs were furnished for stocking various State and national hatcheries, and the remainder produced 56,400,000 fry for local distribution.

Under different management fish-cultural operations were conducted on a more extensive scale than formerly at the Cape Vincent, N. Y., station, resulting in a material increase in the output of the commercial fishes of Lake Ontario. A cooperative arrangement was effected with the New York Conservation Commission for the collection of eggs of the whitefish, lake herring, and lake trout, and new fields were located and operated during the season. The Bureau was accorded the use, without cost, of the traps and nets owned by the State, and in a number of instances spawn takers who had been in the service of the State for a number of years were temporarily employed by the Bureau to take eggs for the Cape Vincent station after the State hatcheries had been filled. After a thorough investigation of the various fields, it was decided that eggs of the whitefish, lake herring, and lake trout could be procured on a more economical basis by purchasing from commercial fishermen on the same basis that was paid by the State, namely, 50 cents per quart.

The collection of whitefish eggs was undertaken at Three Mile Bay, N. Y., at fisheries operated in the vicinity of the Cape Vincent station, and at the Fulton Chain Lakes, at Old Forge, N. Y. The work was conducted in cooperation with the State employees. The egg collections at these points numbered 18,354,000, the largest part of them being from Fulton Chain Lakes, where 16,254,000 were obtained. The number of fry hatched was 18,000,000, which were planted in Lake Ontario in the vicinity of Cape Vincent.

Lake herring eggs to the number of 32,650,000 were secured in the vicinity of Three Mile Bay, N. Y., and 51,350,000 from Great Sodus Bay, at Sodus Point, N. Y. These eggs yielded 79,200,000 fry.

Lake-trout operations were conducted at Charity Shoals and Stony Island, N. Y., and at Horse Shoe Island, Amhurst Island, and Pigeon Island, Canada. Severe winds prevailed during the entire spawning season, but the results of the work were good.

Early in the spring new fields for the collection of pike-perch eggs were located at Black Lake, near Pope Mills, N. Y., and on the Oswegatchie River, at Ogdensburg, N. Y.; and while the work was conducted on an experimental basis the outcome was satisfactory, a total of 17,150,000 eggs being secured.

There were transferred from other stations to Cape Vincent for development 4,500,000 eyed lake-trout eggs and 50,000,000 green pike-perch eggs. The fry produced from all the species propagated during the year numbered 141,530,000.

A peculiarly favorable combination of natural conditions existed during the spring in the vicinity of the Bureau's Swanton station on Lake Champlain, and the work accomplished there in the propagation of pike perch was the most successful in its history. The water in the lake prior to and during the spawning season was so low that it was impossible to utilize the inclosure prepared last year for the holding of immature pike perch to ripen, but under the circumstances there was no necessity for its use.

Brood fish in very large numbers congregated early in spring at the mouth of the Missisquoi River, on which the station is located, and

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as the surrounding marshes where they usually spread out were dry, they ascended the main river, where seining conditions were all that could be desired. As a result of five days' fishing—from April 14 to 18, inclusive—enough ripe fish were seined from the river to more than fill the Swanton hatchery to its capacity, and it became necessary to discontinue the work at a time when the run of fish was apparently at its height. Eggs to the number of 382,800,000 were taken, of which 75,400,000 were forwarded direct from the spawning field to other stations—15,000,000 to the Massachusetts Fish Commission and the remainder to the Cape Vincent hatchery of the Bureau. The percentage of fertility of the eggs hatched, namely, 48.7, was not quite equal to that of the preceding year, but it was remarkably high when one considers the crowded condition of the hatchery and the short space of time in which the eggs had to be handled. In returning the fry to the lake special efforts were made to spread them over as wide a territory as possible, and in order to more effectively accomplish this one of the Bureau's cars was utilized for the distribution, consignments being delivered to interested parties at various places along an extended portion of the lake front.

PROPAGATION OF MIGRATORY FISHES OF THE ATLANTIC STREAMS.

A general falling off occurred in the output of the stations handling the anadromous species of the Atlantic seaboard—the shad, striped bass, white perch, and yellow perch. The decline in the run of shad in the Chesapeake Bay and tributary streams during the spring of 1915 was more marked than in the preceding year, when the run of fish was the smallest in the history of the Bureau's operations with the species.

On Potomac River experienced spawn takers attended every gill net and seine operated in the vicinity of the Bryan's Point hatchery, and a barge equipped with a battery of hatching jars, which were supplied with water by means of a gasoline pump, was stationed at Occoquan Creek, Va., with a crew of four men, to attend the seine fishery at Stony Point and the gill netters operating in that section of the river. Strong northwest winds and low atmospheric and water temperatures prevailed throughout the season. The first eggs were obtained April 21, and during the spawning season, which continued until May 13, the collections amounted to 16,012,000, from which 13,899,000 fry, or less than one-half the output of the previous year, were produced.

Good results attended the operations with the yellow perch, the 19,769 brood fish secured from the local fishermen in February producing 164,775,000 eggs, from which 151,592,000 fry were hatched, and 1,500,000 eyed eggs transferred to Central Station, Washington, D. C., for development. A feature of the yellow-perch work this year at the Bryan's Point station was the hatching of all the eggs in wire baskets swung from poles located in sheltered waters, thus obviating the expense involved in operating pumps, which is necessary when the eggs are developed in the hatchery, as has been the method heretofore pursued.

There was no improvement of conditions as regards the run of shad in Susquehanna River, and the shad operations at the Battery

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Island, Md., station, which is equiped for the handling of 200,000,000 eggs, and where as many as 210,000,000 eggs were formerly secured, were a failure, only 2,866,000 being produced. The expense involved in the operation of steam boilers and pumps was reduced by the installation of a 5-horsepower gasoline pump, which was used exclusively at times when hatching operations required only a limited supply of water.

From the brood yellow perch secured on the Susquehanna River in March and April 64,933,000 eggs were obtained, which yielded 41,825,000 fry. White-perch eggs to the number of 357,250,000 were collected at the mouth of Elk Creek, near Henderson Point, Md., but large losses due to imperfect fertilization reduced the output to 175,330,000 fry. Consignments of yellow-perch and white-perch eggs, aggregating 36,850,000, were donated for development at the State hatcheries in New Jersey and Massachusetts.

The propagation of the alewife, which was undertaken in an experimental way last year, was prosecuted on a more extensive scale during the spring of 1915, with a resulting output of 4,851,000 fry.

On Albemarle Sound the climatic and other physical conditions during the spring of 1915 were identical to those of last season, which proved unfavorable to the shad operations at the Edenton, N. C. station. Although every field where there was a possibility of securing spawn was covered by experienced spawn takers, and the scope of the work was extended to fields in the lower end of the sound heretofore unoccupied, the result of the season's work shows a decrease of 6,333,000 in the output of shad fry as compared with the previous year. The 39,040,000 eggs received at the hatchery from all sources yielded 22,990,000 fry, most of which were distributed in North Carolina, although liberal plants were made in suitable waters in adjacent Southern States.

The usual preparations for propagating striped bass on the Roanoke River at Weldon, N. C., were completed early in April. Suitable traps in which to capture the brood fish and pens for holding them were located at advantageous places in the river, seven collecting points being established adjacent to grounds operated by the commercial fishermen. The prospects in April for a large run of fish were very encouraging, but early in May the river fell to a very low stage, and clear water prevailed throughout the spawning season. Abnormally high temperatures hastened the spawning of the fish, and many of them deposited their eggs in the river. Owing to excessively low water and the faulty construction of the retaining boxes, the penning operations were a failure, as many of the fish held injured themselves so badly that they died before their eggs ripened.

The first eggs were secured April 25, and from that time on collections in limited numbers were made until the end of the spawning season, on May 17, 2,500,000 constituting the largest take of a single day. The difficulty experienced last year in obtaining ripe male fish at the time eggs were available was again encountered, and large losses of eggs occurred through lack of a fertilizing medium. In one instance two females weighing 40 and 35 pounds, respectively, and carrying approximately 5,000,000 eggs, were taken in traps, but as no males were at hand, all of the eggs were lost.

The total egg collections amounted to 11,295,000, from which 6,640,000 were hatched. The discrepancy between the collections and

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the output was due to abnormally high temperatures, which caused a heavy loss of eggs in the hatchery.

The usual extensive Atlantic salmon operations were conducted at the Craig Brook, Me., station during the year. The brood fish collected in the summer and fall of 1914 numbered 693, of which 112 died in the pound, leaving 581 available for fish-cultural work. The 289 females stripped produced 1,954,479 eggs, of which number 1,848,000 were transferred in the eyed stage to the upper Penobscot auxiliary station during the winter for final development, and the 1,804,313 fry resulting from them were liberated in May and June in the east branch of the Penobscot River. The collection of brood fish for propagation in the succeeding fiscal year began May 21 and ended June 19, the number of brood fish secured within that period amounting to 725.

It is the opinion of the superintendent of the Craig Brook station, and also of the Penobscot River fishermen, that Atlantic salmon are as numerous this year as they have been in the past three years. The total catch in the spring of 1915 was a trifle greater than that of the preceding year, which would indicate that this species is holding its own under very adverse conditions.

PROPAGATION OF THE TROUTS AND BASSES.

Generally speaking, very successful work was accomplished during the year at the stations addressed to the propagation of the trouts and basses.

Large gains were made with the brook trout at the Manchester station, the total output being 1,080,000, as compared with 319,800 in 1914. While the average collections of brook and rainbow trout eggs were made at the Wytheville and White Sulphur Springs stations, very heavy losses of fry occurred, the mortality at the former station being due to contamination of the food supply, and at the latter to a decreased water supply, which has been falling off for a number of years.

At Leadville, Colo., where a large percentage of the eggs are collected from open waters, there was a material increase in the output of rainbow trout. The brook-trout egg collections at this station in the fall of 1914 were smaller than in the preceding year, but their quality was better and a larger number of fry were produced.

The total output of the Bozeman and auxiliary stations for the year, amounting to 17,359,436 fish and eggs, was practically 100 per cent above that of the previous year, which aggregated 8,745,538.

It is impossible to present any analysis or comparison of the Yellowstone Park work by fiscal years, owing to the fact that the spawning season of the blackspotted trout occurs in June and July, the last month of one fiscal year and the first month of the succeeding year. The take of eggs of this species in the park for the calendar year 1914 was 12,561,935. Of these eggs 11,463,000 were shipped to various other stations of the Bureau, and 560,000 fry were hatched on the grounds for deposit in suitable waters in the park, making a total distribution of 12,023,000 fish and eggs.

Owing to favorable water conditions and close application to the work, substantial gains were made in the collection of rainbow-trout

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and grayling eggs at the field stations located in the Madison Valley, the total output of the former species being 384,000, while 2,130,000 grayling were distributed in local waters, as compared with an output of 400,000 in 1914.

A large run of rainbow trout occurred in Cottonwood Creek, a tributary of the Klamath River, in California, much earlier in the season than usual, and while the egg collections did not come up to the anticipations based on the numbers of fish in the creek, 2,674,900 were secured, constituting the largest take ever made at this point.

The work of the 26 stations where pond fishes are propagated was conducted along the same general lines as in the past, but on account of the generally favorable climatic conditions prevailing during the spawning season of the various species, the results were unusually gratifying, material increases being made in the output of largemouth and smallmouth black basses, crappies, sunfishes, and catfishes. The distributions of the largemouth and smallmouth black basses were especially satisfactory, that of the former species amounting to 2,190,000, as compared with 822,000 in 1914, while the distributions of smallmouth black bass in public and private waters aggregated 734,000, as opposed to an output of 187,000 the previous year.

The output of the following stations is deemed especially noteworthy:

	Black basses.	Other species.
Mammoth Spring, Ark	1,226,738	512,820
San Marcos, Tex	451,657	43,765
Tupelo, Miss	330,965	84,700
Bullochville, Ga	118,145	53,370

The success of the operations was due largely to a more comprehensive knowledge of the requirements governing pond-fish culture, the adoption of more modern methods, and the promptness in making distributions.

PROPAGATION OF MARINE FISHES.

Notwithstanding the incessant storms that hampered the cod operations off the Massachusetts coast and the shortage in the take of brood fish of several of the species propagated, the work of the New England stations devoted to the cultivation of the marine fishes was in general satisfactory.

At the Boothbay Harbor, Me., station 16,482 brood lobsters were placed in the Pemaquid pound in the fall of 1914 and closely cared for throughout the winter, quantities of small pollock and herring being given them as food. When they were taken from the inclosure in April for the stripping of their eggs, it was ascertained that a larger percentage had survived confinement than in any preceding year in the history of the station, the number removed being 13,917. The lobsters were not particularly well seeded, however, as the yield of eggs averaged less than 12,000, but the total number—164,450,000—was in excess of any former year's production from impounded stock. After their eggs were removed the lobsters were turned over at the prevailing market price of 14 cents a pound to the Maine fisheries authorities, who returned them to the open waters of the ocean off the Maine coast, and later delivered to the Bureau in exchange egg-bearing lobsters of an equal value.

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The collecting of seed lobsters was carried on as usual during the summer of 1914 and the spring of 1915, and from the 1,588 thus handled 34,643,000 eggs were obtained, an average of 21,815 per lobster. From the total number of lobster eggs secured during the year, 193,800,000 fry were produced and planted along the Maine coast.

The cod-fishing fleet operating off Casco Bay in March and April was small and fish were far from plentiful, and only 34,511,000 eggs were collected; these produced 21,841,000 healthy fry.

Early in April the station launches were equipped with a force of spawn takers and sent into the fields off Boothbay and Portland to collect haddock eggs from the fleet of netters operating there. While fish of miscellaneous sizes were fairly abundant, only a few large mature fish were in evidence, and only 3,584,000 eggs of poor quality were taken during the entire fishing season, which extended well into the month of May.

Beginning March 1 and extending through the month of April, men were employed to attend fyke nets set in the vicinity of Boothbay Harbor for the capture of flounders. The work with this species was only moderately successful, a smaller number of brood fish than last year being taken, while the losses of eggs during incubation were greater. The 487,250,000 eggs taken produced 394,499,000 fry.

The major fish-cultural work of the Gloucester station was addressed to the cod, pollock, haddock, flounder, and lobster, and operations with one or more species were in progress almost continuously for eight months beginning November 1, when the first collection of pollock eggs was made. During the first six weeks of the pollock spawning season, which extended to February 9, there were indications that the take of eggs would exceed that of 1914, but a series of heavy storms in December scattered the schools of fish and drove them off the fishing grounds and completely destroyed the fishermen's nets. Although 855,020,000 eggs were taken, this number was considerably less than in the previous year. Owing to a scarcity of spawning cod throughout the winter and spring on the inshore fishing grounds, the take of eggs at Gloucester was comparatively light, aggregating 82,460,000, which produced 52,250,000 fry; these were deposited in local waters with 18,030,000 fry hatched from eggs sent to the Gloucester station from Woods Hole.

The hatching of the winter flounder, which was taken up February 24, was greatly handicapped by the scarcity of brood fish, resulting from excessive fishing operations during the previous summer and fall. From the 276 spawning fish secured from the fishermen, 134,180,000 eggs were taken and 121,090,000 fry hatched and distributed.

Small collections of haddock eggs were made between March 13 and April 28, the season's collections amounting to 38,410,000, from which 25,840,000 fry were hatched and returned to the spawning grounds, the last of them being liberated on May 10.

Active fish-cultural work at the Woods Hole station began on November 27, 1914, with the delivery of 1,500 brood cod obtained from commercial fishermen. Later acquisitions brought the total brood stock of the station up to 3,068, of which 1,310 were placed in the cistern and the remainder in live cars. The steamer *Phalarope* was stationed at the beginning of the spawning season on the fishing

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grounds near Plymouth to collect eggs from any ripe cod which might be taken by commercial fishermen, but severe weather and fogs so hampered their operations that most of the fishermen left the grounds at an early date; consequently the total receipts of eggs from that field amounted to 7,663,000. These, added to the eggs secured from brood fish held at the station, gave a total of 270,504,000, of which a consignment of 24,630,000 was transferred at the height of the collecting season to the Gloucester station. From the remaining 245,874,000 eggs, fry to the number of 168,012,000 were hatched and liberated in the coastal waters of Massachusetts.

The first brood flounders were received at the station on January 16, having been taken in fyke nets set in the immediate vicinity. A few days later captures of ripe fish were made at the field station at Waquoit Bay, and on February 26 collections were undertaken at Wickford, R. I. The fairly favorable weather conditions for the work during the late winter permitted the collection of 1,053,285,000 eggs, or about 15 per cent more than that of the previous year. The average fertility of the stock was somewhat below the average, but this handicap was offset to a considerable extent by the uniformly suitable water temperatures prevailing during the hatching season, and the final outcome of the work with this species was the distribution of 778,567,000 fry on the spawning grounds along the Massachusetts coast.

At the close of the flounder work the station was fitted up for the propagation of such summer-spawning fishes as might be secured from surrounding waters, and small quantities of mackerel and tautog eggs were taken and hatched.

RESCUE OF FISHES FROM OVERFLOWED LANDS.

One of the most important branches of the Bureau's operations is the rescue of young food fishes from the lakes and bayous formed by the overflow of the Mississippi and Illinois rivers and their tributaries. In the fiscal year 1915 operations of this character were conducted at the stations located on the upper Mississippi River at La Crosse, Wis., Bellevue and North McGregor, Iowa, and Homer, Minn.; on the Illinois River, at Meredosia, Ill., and on the lower Mississippi River at Friars Point, Miss.

Favorable water stages made it possible to operate these stations from the receding of the floods in July until the latter part of December. The total collections of all species of river fishes numbered approximately 8,357,000. Of this number 551,000 were delivered to applicants and deposited in public waters, the distributions involving 34 carloads of fish, in addition to the deliveries made by detached messengers. Fishes of all species to the number of 7,806,000 were rescued from landlocked waters in the vicinity of the fields of operation and returned to the main rivers. The output for the season is regarded as satisfactory, the distribution being three times as large as last year.

As has been explained in previous reports, the many hundreds of thousands of young fishes resulting from the Bureau's seining operations along these rivers are taken from landlocked bayous and lakes

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where they would perish from drought, or from cold later in the year, if allowed to remain. Of the total number of fish collected, fully 90 per cent are returned to the rivers where they originated.

ACCLIMATIZATION.

In continuance of the efforts to establish the Atlantic lobster on the Pacific coast, a shipment consisting of 6,000 adult lobsters—3,100 females and 2,900 males—was forwarded in a refrigerator car on November 16 from Boothbay Harbor, Me., to Anacortes, Wash. The lobsters were packed in crates, as heretofore, between layers of rockweed, and while en route were daily sprinkled with salt water, an even temperature of 40° F. being maintained during the entire trip. Through an error of the express company in routing the car, the trip was made 250 miles longer than necessary and a delay of 24 hours in delivery resulted. On the arrival of the car at Anacortes the loss en route was ascertained to have been 1,051 female and 1,345 male lobsters. Owing to the weak condition of a portion of the survivors 865 females and 739 males were planted in suitable places in the harbor off Anacortes, and the remainder of the consignment was transferred to live cars anchored in Puget Sound and allowed 24 hours in which to recuperate. The following day, after delivering 100 at Anacortes, for shipment to Japan, the lobsters were towed to Deer Harbor, in the San Juan Islands, Puget Sound, and liberated in good condition.

In November, 1914, a third consignment of 7,000,000 eyed humpback salmon eggs was forwarded from Puget Sound to New England and divided equally between the Craig Brook and Green Lake hatcheries. The fry resulting from them, 4,964,757 in all, were distributed in various tributaries of the Penobscot River and other selected streams.

BIOLOGICAL INVESTIGATIONS, SURVEYS, ETC.

PROBLEMS OF THE OYSTER INDUSTRY.

Of all American food products derived from the water, the oyster merits first consideration. In nutritive qualities it is surpassed by none; in the total value of the product marketed and consumed the oyster ranks first; no fishery resource is more widely distributed on the seacoast; and none lends itself to artificial cultivation so readily as the oyster. In certain regions oyster growing has reached a very high degree of development, and it may be cited as the only fish-cultural industry which has been largely developed through private enterprise. Nevertheless, the industry is yet quite too restricted in comparison with the wide distribution of the oyster, and with the extent of the barren bottoms that could be made productive through human efforts.

The natural development of commercial oyster culture is seriously hampered both by peculiar conditions of an economic nature, and by the failure to apply scientific methods in an adequate way to many of the elementary problems involved. The Bureau has endeavored at all times render all practicable aid to this important industry and to awaken a merited interest in the subject on the part of the public, of State officials, and of all persons engaged in the industry.

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In continuation of its practice of cooperation with State authorities, and in accordance with the authorization and direction of Congress, the Bureau has during the past fiscal year conducted a survey of the Apalachicola Bay, Fla. The steamer *Fish Hawk* and qualified assistants from the central office were engaged in the investigation, the purpose of which was to determine the extent of the natural oyster beds and of the bottoms suitable for the production of additional quantities of oysters through methods of culture.

In addition to utilizing the services of its permanent assistants in such efforts, the Bureau has engaged the temporary services of qualified investigators at one of its laboratories in attacking problems of vital importance to the welfare of the oyster industries. Among these problems there may be mentioned that presented by the condition known as "greening," which, to a more and more serious degree, is manifesting itself in certain important oyster regions with the effect of rendering the oysters unmarketable. Other investigations relate to unsolved problems of propagation and of fattening of oysters.

The possibilities of a higher development of oyster culture on the Pacific coast are receiving attention, and the Bureau has engaged the temporary services of an investigator whose studies are now directed to acquiring the necessary knowledge of the life history and conditions of development of both the native and the introduced Eastern oysters.

Although these investigations have not yet reached a stage justifying a published report, the progress is so encouraging as to demand the continued application of available means to these investigations. It has been urgently recommended that special and adequate provision should be made, so that the success of the efforts of the Bureau may not be contingent upon the use of temporary agents who can devote but a few weeks of the year to studies that are of vital importance to a national industry.

THE HOME FISH POND.

In certain phases the fisheries have already passed from the condition of exploitation of natural resources to one of at least partial dependence upon methods of artificial propagation, and yet, in this country at least, the principle of communism largely controls. A striking exception is elsewhere alluded to in connection with the important industry of oyster culture, or commercial oyster farming. There are many evidences of increasing interest in the rearing of fish in small ponds on the farm. Whatever may be said of the commercial possibilities of such a practice, there is no question but that a desirable and convenient addition to the food supply of the home may thus be provided with inconsiderable expenditure of money or labor, and with collateral advantages that are not insignificant. In every way possible the Bureau places its accumulated experience at the disposal of the persons interested. It desires to do more than this, however, and, through the only one of its biological stations that is suited to the purpose, it is attempting to conduct experiments and investigations that will bear directly upon the practical problems confronting the

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owner of a home fish pond. Such experiments can be imposed upon the biological station at Fairport, Iowa, not only without hampering its primary functions in the propagation of fresh-water mussels, but in a way to materially further that object. In connection with the experimental fish culture there is accumulated a store of experience, but there is also made available a surplus stock of young fishes which may be used in the propagation of mussels.

Some of these experiments are being conducted with such favorite fishes as the bass and bream. An important one undertaken during the past fiscal year is the rearing of young buffalofishes from eggs artificially fertilized and hatched. While the larger number of the buffalo fry were liberated in the Mississippi River soon after hatching, a pond of about an acre in extent was stocked with 180,000 of these fish as the beginning of an experiment to determine the feasibility of rearing them in artificial ponds. This is not known to have been attempted before, but the Bureau is gratified to record that at the close of the fiscal year the results are quite encouraging. These experiments in the artificial propagation and rearing of the buffalofish are to be regarded as of particular importance, since this species is a valuable commercial fish that is regularly diminishing in numbers in the public waters. As a pond fish it has the advantage of attaining a large size, of being without cannibalistic tendencies, and seemingly adapted for practicable methods of artificial feeding.

The results of such experiments will be of value not only in pointing the way for more effective conservation of the fish in public waters, but also by giving due encouragement and assistance to those who would utilize privately owned waters for the production of fish food. The fish-cultural work at this station will be extended as additional ponds may be constructed.

LIFE HISTORIES AND HABITS OF FISHES.

It is manifest that in order to arrive at intelligent conclusions regarding the necessities and the proper modes of protection of marine fishes, and to determine the possibilities of promoting an increase through artificial propagation, it is essential to have a reasonably complete knowledge of their life histories and habits. The problem is easily stated, but the solution offers peculiar difficulties. One can not casually walk along the shores and observe the activities and the propagation of fishes. Systematic plans of study must be evolved so that the fishes are collected and observed at various places and during the different seasons. In the end a variety of methods of collecting and of study must be followed. The eggs and the larval fishes and the adults are not all obtained at the same time or by the same forms of apparatus. Chance, indeed, plays an important part in the investigations. The eggs or the larvæ may be obtained free in the water before the adult fishes are found in the condition of breeding. It is necessary to be able to identify the small forms whenever they are found, but familiarity with the adult fishes does not enable one to do this. The young are generally so dissimilar to the adults that eggs or larvæ of a common fish may be discovered, studied, and figured without determining the species of its parentage. This explains why it is necessary to undertake systematic studies of

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all larval forms obtainable, and to follow, as opportunity offers, the life history of every available fish. When once a study has been carried out in a sufficient way, it will become possible to recognize any species of fish in any form in which it is encountered, and then the data gathered from systematic collecting can be intelligently collated and used as a basis for correct inferences regarding the migrations and life histories of important fishes.

The Bureau has been attacking this general problem in a serious way, and will continue to do so with the assurance that after a term of years sufficient knowledge will have been gained to remove some of the most palpable obstacles to its more effective service for the conservation and propagation of valuable food fishes. During the early part of the fiscal year one of the regular assistants and a temporary investigator were engaged in such an investigation of the larval development of fishes at the Beaufort laboratory. In order to extend the territory of observation the investigation was resumed at Woods Hole in June, 1915, but the opportunities for collecting were found to be inferior to those at Beaufort. The director of the Beaufort laboratory was enabled to make observations during the winter season which throw light upon the breeding habits of such important fishes as the "gray trout" and the mullet. Additional material for study is obtained in connection with the oceanographic observations of the schooner *Grampus* and the steamer *Fish Hawk*.

The same problem is being attacked from a different angle through a study of the markings of the scales of fishes, since recent scientific investigations have shown the possibility of ascertaining the age and of making certain inferences regarding life histories from the form and arrangement of the minute markings on the scales.

Such studies have not been confined exclusively to the marine species. A series of studies of the fresh-water fishes of the Mississippi River was in progress in Lake Pepin, but it has suffered temporary interruption through the transfer of the scientific assistant in charge to become director of the biological station at Fairport, Iowa. In connection with the same station, one of the permanent assistants has been detailed to Keokuk, Iowa, during a considerable portion of the year. The presence of the dam across the Mississippi at this point creates a favorable condition for certain sorts of studies of the movements and habits of fishes. It is the desire of the Bureau to continue systematic observations in this region, not only for the purpose of gaining additional knowledge of the habits of fishes, but also with the object of learning from actual experience what is the effect of water-power developments upon the general condition of fish life in the larger rivers.

An important field of study relates to the food of fishes. It is evident that the abundance of fishes in any body of water must be limited by the amount of available food. All fishes do not take the same sorts of food, nor does any given species of fish subsist upon the same kind of food at all stages of its existence. Furthermore, since fish do not lay by stores of food in time of plenty, excess at a particular season will not tide the fish over too extended a period of scarcity. It may then be said that the abundance of any fish is limited by the minimum quantity of its food present at the time when it is required. The Bureau finds itself unable to undertake

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extended series of investigations of the food of fishes, but, as an effort in the right direction, it has secured the temporary services of a competent investigator at Madison, Wis., for the study of the food of a selected species throughout the entire year.

In this connection, reference should be made to the continuation of the practice of giving encouragement and financial aid to specialists in the prosecution of sytematic studies of certain groups of aquatic animals and plants. Studies of this nature now in progress at the Beaufort laboratory relate to the protozoa and to the diatoms, very low forms of animals and plants, respectively, but forms that play a very significant part in the economy of aquatic life, and which in various direct and indirect ways bear upon the fortunes of life of the larger animals.

SURVEY OF FISHING GROUNDS.

It was expected that the examination of the fishing banks off the coasts of Washington and Oregon, which was begun in the preceding fiscal year, would be reinstituted early in July, but the *Albatross*, which had been used for the purpose, was unexpectedly detained in Alaska and could not commence the work until August 27, and the onset of stormy weather caused it to be discontinued on September 10. The interval between July 1 and the beginning of the *Albatross* operations was occupied in conducting the investigations by means of chartered boats operating from the shore. The results of the survey were very satisfactory, several new small halibut grounds being discovered and a previously little known bank off Newport, Oreg., being thoroughly examined. It was found that halibut were present in this region in paying quantities through at least part of the year, and, in consequence of the investigation, the attention of the fishermen was attracted to this fact, and a small but profitable fishery was inaugurated. The activities of the fishermen thereby induced in this region have resulted in the discovery of other grounds, particularly one lying off the mouth of the Columbia River in an area between the zones covered by the *Albatross* survey. It is not expected that the banks already discovered, and probably not those which may be found in the future, will in any way equal in extent and productiveness those in Alaska, but there appears to be no doubt that they can furnish a considerable supply of fish readily accessible to the primary markets. In June, 1915, about 40 per cent of the halibut landed at Seattle came from these grounds. The deficiency of funds made it impossible to undertake this survey when the weather was favorable in the spring of 1915, but at the close of the fiscal year the *Albatross* was under orders to proceed with the work as soon as possible after the first of July.

During the preceding fiscal year the Bureau published an economic circular calling attention to the opportunities for a large blackfish fishery offshore from North and South Carolina. While the blackfish grounds are very productive they are very restricted in area. During the past fiscal year the Bureau has detailed the steamer *Fish Hawk* to continue the survey with the object of determining the full extent of the grounds. The survey was in progress at the close of the fiscal year. Through the assistance of the Bureau of Lighthouses

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a permanent buoy was placed upon the principal grounds known and described as the Beaufort offshore fishing grounds, in the hope that such a mark would aid and stimulate the local fishermen who might be without the equipment or the experience to enable them to locate such a circumscribed area by methods of navigation.

THE DISEASES OF FISHES.

It is not generally realized to what extent fishes are subject to parasitism and to what degree their existence is contingent upon the less obvious factors of environment. Without presenting the conspicuous features of an epidemic, certain of the ever-present parasites may so reduce the vitality of individual fishes as to cause them to fall an easier prey to voracious enemies. Deleterious chemicals may be introduced into the water, not only through evident sources of pollution, but through very indirect, unintentional, and ordinarily unobservable means. Furthermore, the effect of the introduction of chemicals or of commercial waste products, or of natural débris, when it is without direct poisonous effect, may give rise to such chemical reactions in the water as to render the environment unsuitable for the support of fish life.

With the services of temporary investigators at its various laboratories the Bureau has made special efforts to investigate the effects of various sorts of pollution, to study the forms and the life histories of the different kinds of parasites, and to determine the modes of transmission of infection. The general object has been to lay such a foundation of familiarity with the facts as to be able to determine the means of control. The Bureau receives a large number of reports and inquiries from the public relating to the occurrence of unusual conditions of mortality among the fishes both in private and in public waters. Such matters are of proper concern to the Government, and every possible effort has been made to render appropriate service.

In the lack of any permanent assistant qualified in the study of such matters, and familiar with the practical conditions involved, the Bureau has been seriously hampered in its effort to do justice to the demands made upon it. This deficiency will not be felt in the future as in the past, since Congress has made provision for the employment of a competent assistant to serve as fish pathologist.

FRESH-WATER MUSSELS.

The propagation of fresh-water mussels shows continued development. The number of larval mussels planted was 344,655,260, an increase of 50 per cent over the output of the preceding year. In connection with the mussel propagation, 32,650 adult and 15,083 fingerling fishes were rescued from overflow ponds. As the result, partly of greater efficiency and partly of somewhat more favorable weather conditions, the unit cost was still further reduced, being 2.7 cents per thousand glochidia planted, as compared with 4.3 cents per thousand in 1914 and about 7 cents in 1913. Experiments are also being conducted to determine the feasibility of rearing certain valuable species of fresh-water mussels in crates or in ponds, and an encouraging degree of success marks the progress of the experiments during

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this year. Thus, a few fishes were infected with glochidia of a species of mucket from Lake Pepin, and placed temporarily in a floating basket in the river at Fairport. Over 200 young mussels developed in this basket, where they were retained during the entire fiscal year. Other mussels were reared in an open pond and some in small aquaria. In the two experiments in the river and in a pond a very rapid growth occurred, some individuals attaining a length of more than 1 inch in the course of about five and one-half months' growth.

The Bureau is utilizing the excellent facilities at the Fairport station in the prosecution of several problems that are of direct importance to the mussel industries. Experiments have been conducted to determine the effect upon the mussel beds of some of the common instruments of capture; the possibility of the utilization of mussel meats is under investigation; the study of the nature and cause of pearl formation has been continued; and especial attention is given to the important problem of the relation of the fresh-water mussels to the various species of fish that serve as hosts during the period of parasitism.

An investigation of the mussel resources of the Ohio River was begun before the close of the preceding fiscal year, and continued until the fall of 1914. The results of the field observations are now being compiled to be made public as soon as possible. A brief examination of the mussel beds of the Tensas River, La., made in November, 1914, revealed the presence of considerable quantities of mussels of medium quality, and a circular was promptly issued embodying a report of the observations. A similar examination was made of mussel beds in a portion of the Apalachicola River of Florida. The shells were of excellent appearance, but will require to be carefully tested for commercial qualities; the tests could not be executed before the end of the fiscal year.

THE FISHERIES LABORATORIES.

Fairport, Iowa.—The biological station at Fairport, Iowa, was complete in its essential features and the main laboratory building was opened for permanent occupancy in June, just preceding the beginning of this fiscal year. At all stages in the construction and organization of this station the Bureau has had reason to feel gratified at the sympathetic public interest which has been manifested in its intended service. The establishment of the station was authorized by Congress in 1908, and its construction was begun in the following autumn. Within a few months a temporary equipment was ready, and the experiments in mussel propagation began in June, 1910. The propagation of mussels on a practical scale was entered upon in 1912. During the following year the laboratory building was completed. At the time of the actual opening of the building in June, 1914, there were urgent local requests for a formal celebration of the opening with exercises of dedication, and such an occasion was authorized to be held on August 4, 1914. The attendance of some 5,000 persons coming from various distances, the sympathetic addresses by men of prominence in public life and by scientific men of established repute, and the presentation of a memorial tablet, were regarded as exceptional manifestations of public interest, and

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as a gratifying indorsement of the purposes of the Bureau as expressed by this new endeavor.

This station will not only render valuable service in the propagation of fresh-water mussels and the conduct of investigations relating to these resources, but it will be the means of keeping the Bureau in closer touch with the fishery problems of the Mississippi Basin, for which it may serve as a center. The possibilities and the duty of linking fish-cultural experiment work with mussel propagation has already been discussed, and the Bureau thus finds itself with some equipment which had not otherwise been provided for a phase of service to fish culture and fisheries that is of the broadest general significance.

The various activities of the Fairport station are discussed under the several headings of "Fresh-water mussels," "Home fish pond," "Life histories of fishes," and "Parasites of fishes."

Woods Hole, Mass.—The fisheries laboratory at Woods Hole has been open as usual during the summer season. Its relatively extensive equipment makes it an especially favorable place for the prosecution of the more technical investigations, while its intermediate location between the great oyster grounds of Long Island Sound and the fishery ports of the eastern coast makes it a convenient center for investigations in the interest of the fisheries of that territory. Some of the studies pursued at the Woods Hole laboratory during this year were concerned with the oyster, with the life history and food of fishes, and with the parasites of fishes, subjects that are referred to elsewhere in this report. Other inquiries relate to the utilization of waste fishes and of other aquatic forms that do not now enter into commerce, with the oxygen requirements and the metabolism of fishes, and with the effect of various mineral salts which are introduced into the waters either through direct and indirect means of pollution.

The Woods Hole laboratory is the oldest station of the Bureau. Its history and its public service are closely linked with that of the Bureau and the earlier Fish Commission for which it once served as temporary headquarters. After more than 30 years of usefulness the laboratory building and equipment are not in a commendable state of repair. It is desirable that suitable provision be made for its renovation.

Beaufort, N. C.—The buildings and grounds of the Beaufort laboratory have been improved during the fiscal year, the additional work being rendered possible by special appropriation. The formerly uneven and sandy surface of the island has been graded to an approximate level and given a thin covering of rich soil. Several kinds of grass have been planted with a view to protection from the annoyance and possible losses due to wind driven sand. A slight extension of the area of the island occurred through the dumping of materials obtained from the dredging operations carried on in Beaufort Harbor under the War Department.

Space for storage of coal was provided in connection with the pump house, so that the coal shed could be converted into a boat house and thus provide much needed facilities for the repair and repainting of the station boats. Additional concrete inclosures were provided for experimental work. A large salt-water pump was purchased, making it possible to maintain an adequate supply of sea

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water, while reducing the hours of pumping to a fraction of the time formerly required.

A good deal of work was done on the laboratory building. A new roof of slate was applied, the wood piles supporting the building were replaced by brick piers; the salt-water plumbing was renewed; 48 defective window frames were replaced by new frames; two additional rooms were formed by partitions which cut off portions of the large museum space on the first floor; the walls and interior wood work were renovated with calcium and varnish; and the appearance of the building was much improved by the addition of upper porches on the front similar to the porches originally provided on the rear of the building.

The several activities of this laboratory have previously been detailed in connection with the studies of the terrapin, the habits and life histories of fishes, the survey of fishing grounds, and the study of parasites of fishes. Another important investigation which has been in progress during the past two years has to do with the protection of wood against marine borers.

The serviceability of this station would be greatly enhanced were it provided with an adequate scientific staff so that investigations of important economic bearing might be continued throughout the year. Under present conditions, when the station must depend for its staff largely upon the temporary employment of scientists from the universities, the period of activity must be confined largely to the summer months.

Gulf of Mexico.—A previous Congress provided for the construction of a marine biological laboratory on the Gulf of Mexico, to be located upon the coast of Florida and on lands to be donated to the Government. A site has been selected at Key West and the present owners are putting the grounds into a shape suitable for acceptance by the Department. It is supposed that the transfer of title will be effected in the early part of the next fiscal year. An additional appropriation is needed before the station can be constructed.

OTHER INVESTIGATIONS.

Cultivation of the diamond-back terrapin.—Previous reports have referred to the successful progress of the experiments in terrapin propagation. The main fact having been previously demonstrated, that the terrapin can be successfully reared in confinement, the experiments have been continued to gain additional knowledge and thus assure the greater measure of success in propagation. It is interesting to record that the terrapin of the brood of 1909 have now completed the life cycle, so that eggs were obtained this past spring from terrapin which were hatched from eggs laid in the experimental pounds in 1909. The breeding terrapin were thus 6 years of age. Since 1909, however, the practice of winter feeding for the young terrapin has been initiated, so that the rate of growth during the first year has been practically doubled. During the past winter a change of food was adopted with the result of still further accelerating growth. The longer the investigation has been continued the more encouraging have been the results. Further experiments are now in progress to determine the proper proportions of the sexes in breeding, the best conditions for hatching, the possibilities of cross and

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selective breeding, and the prevention of mortality. Since the yearly hatch in the experimental pounds is now much larger than is required for the continuation of the work, the Bureau liberated in the marshes of Beaufort Harbor in September, 1914, 876 yearling terrapin.

Study of frogs.—The correspondence of the Bureau reveals a very widespread interest in the subject of frog culture. Many ventures in the rearing of frogs for commercial profit have been made, but it does not appear that the results generally obtained have represented a distinct improvement over the natural conditions. Since the edible frogs are prolific breeders by nature and since the young will develop under a variety of conditions in pools and marshes, it appears evident that the problem of frog culture is not one of manipulation of the eggs, but rather one of providing such an abundance of food that a large proportion of the young may come to maturity and a desirable rate of growth be secured. During this fiscal year the Bureau has secured the services of a skilled investigator who will conduct a careful inquiry into the feeding habits, rate of growth, and conditions of existence of the commercial species of frogs.

Investigation of the salmon.—The study of the life history of the salmon of the Sacramento and Columbia rivers has been continued throughout the fiscal year. Just before the close of the year arrangements were made for further investigations of the breeding habits of the salmons in the hope of gaining knowledge of practical utility in the conservation and propagation of these fishes.

Investigation of the tuna.—Within the past few years there has developed a very important industry in the canning of tuna on the Pacific coast. The product has already won a place of high esteem and a new fishery resource is thus discovered. Unfortunately for the highest development of the industry, the tuna can not be counted upon to appear in abundance with any regularity, and the conditions which induce the appearance or disappearance of the fishes are not understood. It has been the desire of the Bureau to investigate the habits of this fish in a thorough way and to follow their movements upon the open sea. Through the services of a temporary assistant a preliminary inquiry was conducted, and a number of fish were marked in the hope that some of them may be recovered at a later time and light thrown upon their migrations and rate of growth. An adequate investigation could be conducted only with the use of a seaworthy vessel, such as the *Albatross*. The limited funds available for the operation of this vessel and the fact of other and prior demands for its services made it impracticable to make a suitable disposition for continuance of the inquiry.

OCEANOGRAPHIC STUDIES.

The important oceanographic work carried on by the Bureau partly upon its own resources and partly in cooperation with the Coast Guard, was detailed in the last annual report. During the present fiscal year an assistant from the Bureau has been regularly detailed for oceanographical observations upon the revenue cutter *Seneca* engaged in ice patrol and observation on the trans-Atlantic steamship lanes. From May 4 to the close of the fiscal year the schooner *Grampus* has been regularly employed in oceanographic observations off the coast of New England. The observa-

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tions are of value in determining the conditions of temperature, densities, ocean currents, and other physical factors that affect the distribution, migration, and successful propagation of fishes; particular attention has also been given to the collection of material which would contribute to a knowledge of the life histories and habits of important food fishes.

INVESTIGATION OF LAKES.

The Bureau has continued to cooperate with the State Geological and Natural History Survey of Wisconsin in an investigation of the fundamental biological and physical conditions of life in inclosed waters. The examination of Lake Champlain, which was commenced in the preceding year, was brought nearly to completion, and a report is expected to be ready in the course of the next fiscal year.

SERVICE IN PROMOTION OF FISHERY LEGISLATION.

While the Bureau is charged with the duties of propagating fishes and of conducting investigations in relation to the fishes and the fishery industries, it has a natural obligation and desire to give encouragement and advice in the matter of legislation whenever its aid is solicited. Within the year a number of occasions have arisen in which the Bureau could cooperate with State authorities in the consideration of measures of protection or conservation. The Bureau has been represented in such conferences with the authorities of the States of Florida, Georgia, and North Carolina, and has also participated in a joint conference of the State officials of Wisconsin, Minnesota, Iowa, and Illinois with respect to mussel legislation. In many directions our fishery resources are being wasted through the inadequacy of the efforts for protection or conservation, and every judicious step toward the desired ends is deserving of the most cordial indorsement.

THE COMMERCIAL FISHERIES.

With the small field force available, the Bureau has made canvasses of certain branches of the fishing industry, and through local agents has continued and extended the collection of data for important offshore vessel fisheries of both the Atlantic and the Pacific coasts.

THE LOBSTER FISHERY.

A canvass of the lobster fishery of the entire Atlantic coast was completed during the year, and a one-sheet bulletin giving the results of the canvass was issued and widely distributed. The lobster fishery has been attracting much attention because of its critical condition in some States, and in the next few years will undoubtedly receive unusual consideration at the hands of persons having concern for the welfare of this valuable industry.

Lobsters are caught along the entire coast, from the most eastern point in Maine to the Breakwater at Lewes, Del. The number of persons engaged in the fishery in 1913 was 4,508, and the total investment was $2,460,898. The catch amounted to 8,832,017 lobsters, weighing 12,067,017 pounds and valued at $2,394,822. The details of the fishery in each State are shown in the following table:

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Lobster Fishery of the Atlantic Coast States in 1913.

State and county.	Persons engaged.					Vessels fishing.			Vessels transporting.			Boats.	
	On vessels fishing.	On vessels transporting.	In shore or boat fisheries.	In wholesale establishments.	Total.	Number.	Net tonnage.	Value.	Number.	Net tonnage.	Value.	Number.	Value.
Maine:													
Washington	4	11	534	9	558	2	10	$740	5	50	$11,800	499	$80,040
Hancock	26	32	604	1	663	13	85	8,260	15	160	25,800	564	133,290
Knox	14	40	479	68	601	8	57	6,460	19	212	39,880	459	121,685
Lincoln	.....	4	291	11	306	.....	.....	.....	2	17	3,740	281	50,175
Sagadahoc	.....	.....	82	7	89	.....	.....	.....	.....	.....	.....	78	13,175
Cumberland	.....	26	326	32	384	.....	.....	.....	12	139	21,915	312	55,985
York	.....	.....	185	6	191	.....	.....	.....	.....	.....	.....	172	33,405
Total	44	113	2,501	134	2,792	23	152	15,460	53	578	103,135	2,365	487,755
New Hampshire: Rockingham	.....	.....	80	.....	80	.....	.....	.....	.....	.....	.....	74	12,130
Massachusetts:													
Essex	.....	.....	193	6	199	.....	.....	.....	.....	.....	.....	183	49,350
Suffolk	.....	26	15	111	152	.....	.....	.....	11	146	31,525	14	3,225
Norfolk	.....	.....	32	.....	32	.....	.....	.....	.....	.....	.....	32	7,150
Plymouth	.....	.....	179	3	182	.....	.....	.....	.....	.....	.....	172	31,910
Barnstable	.....	.....	64	.....	64	.....	.....	.....	.....	.....	.....	62	12,455
Nantucket	.....	.....	8	.....	8	.....	.....	.....	.....	.....	.....	7	800
Dukes	.....	.....	33	.....	33	.....	.....	.....	.....	.....	.....	31	9,760
Bristol	.....	.....	28	.....	28	.....	.....	.....	.....	.....	.....	24	7,425
Total	.....	26	552	120	698	.....	.....	.....	11	146	31,525	525	122,075
Rhode Island:													
Newport and Bristol	12	.....	207	11	230	5	32	6,290	.....	.....	.....	170	58,620
Washington and Kent	.....	.....	81	.....	81	.....	.....	.....	.....	.....	.....	62	11,680
Total	12	.....	289	11	311	5	32	6,290	.....	.....	.....	232	70,300
Connecticut:													
New London	9	.....	178	.....	187	3	20	5,160	.....	.....	.....	195	40,249
Middlesex	.....	.....	34	.....	34	.....	.....	.....	.....	.....	.....	45	7,420
New Haven	.....	.....	80	.....	80	.....	.....	.....	.....	.....	.....	99	11,697
Fairfield	[a] 10	.....	64	.....	74	[a] 4	34	5,930	.....	.....	.....	85	11,265
Total	19	.....	356	.....	375	7	54	11,090	.....	.....	.....	424	70,631

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New York:													
Suffolk	7		53		60	3	22	8,060				40	16,475
Nassau			13		13							8	3,800
Kings	30		26		56	9	79	10,585				20	3,295
Richmond	6		10		16	2	32	2,060				3	990
Westchester			9		9							7	690
Total	43		111		154	14	133	20,705				78	25,250
New Jersey: Monmouth and Hudson	10		75		85	3	44	6,290				42	14,035
Delaware: Sussex			13		13							8	1,985
Grand total	128	139	3,977	265	4,508	52	415	59,833	64	724	134,660	3,748	804,161

[a] Includes 1 vessel and crew from New Haven County.

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LOBSTER FISHERY OF THE ATLANTIC COAST STATES IN 1913—Continued.

State and county.	Lobster pots.		Lobster cars.		Shore and accessory property.	Cash capital.	Total investment.	Lobsters caught.		
	Number.	Value.	Number.	Value.				Number.	Pounds.	Value.
Maine:										
Washington	41,830	$54,821	459	$4,147	$27,900	$13,000	$192,448	792,370	1,187,475	$237,495
Hancock	43,955	59,057	490	3,747	19,250	5,000	254,404	1,429,867	2,126,575	428,415
Knox	32,460	45,129	446	10,027	60,225	170,500	453,906	1,168,753	1,755,955	351,187
Lincoln	20,779	28,362	234	1,616	37,270	18,000	139,163	523,952	755,040	152,525
Sagadahoc	3,125	4,688	70	670	400	2,500	21,433	218,332	317,500	62,650
Cumberland	15,250	22,888	271	5,355	56,075	143,000	305,218	589,977	887,415	176,361
York	10,529	16,710	139	875	2,400	1,800	55,190	433,796	640,707	117,143
Total	167,928	231,655	2,109	26,437	[a] 203,520	353,800	1,421,762	5,157,047	7,670,667	1,525,776
New Hampshire:										
Rockingham	4,665	8,875	51	170	700	.....	21,875	261,081	301,710	108,560
Massachusetts:										
Essex	10,166	13,690	113	981	4,150	10,000	78,171	457,015	574,039	102,471
Suffolk	790	1,030	98	13,620	168,500	250,500	468,400	30,562	38,227	7,024
Norfolk	2,752	3,465	30	129	100	.....	10,844	158,031	197,534	35,568
Plymouth	10,978	13,705	120	1,136	1,600	12,000	60,351	403,465	489,773	102,809
Barnstable	2,855	3,600	46	188	100	.....	16,343	45,423	99,225	16,697
Nantucket	310	385	5	25	.....	.....	1,210	3,200	6,600	1,320
Dukes	2,235	2,775	29	145	200	.....	12,880	76,124	95,006	15,622
Bristol	1,738	1,980	18	90	150	.....	9,645	23,985	23,985	8,912
Total	31,824	40,630	459	16,314	174,800	272,500	657,844	1,197,805	1,524,389	290,423
Rhode Island:										
Newport and Bristol	17,472	21,650	140	1,995	5,600	33,000	127,155	920,180	1,128,069	173,158
Washington and Kent	5,155	6,670	48	89	2,000	.....	20,439	124,128	154,987	24,802
Total	22,627	28,320	188	2,084	7,600	33,000	147,594	1,044,308	1,283,056	197,960
Connecticut:										
New London	13,507	20,687	97	300	1,000	.....	67,396	363,743	445,574	72,280
Middlesex	1,264	1,716	48	155	100	.....	9,391	29,474	40,237	7,863
New Haven	3,467	4,919	100	284	350	.....	17,250	107,775	135,519	29,268
Fairfield	3,742	5,334	71	245	300	.....	23,074	74,242	103,105	22,356
Total	21,980	32,656	316	984	1,750	.....	117,111	575,234	724,435	131,767

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New York:										
Suffolk	4,907	7,125	.....	.....	.....	.....	31,660	186,930	242,716	46,860
Nassau	637	787	3	26	.....	.....	4,613	9,670	11,600	2,570
Kings	4,930	5,180	16	78	500	.....	19,638	113,025	137,195	24,347
Richmond	1,045	1,095	5	85	100	.....	4,330	33,425	36,700	6,231
Westchester	122	145	10	35	.....	.....	880	5,500	7,600	1,775
Total	11,641	14,332	34	224	600	.....	61,121	348,550	435,811	81,783
New Jersey: Monmouth and Hudson	7,696	8,537	88	701	1,600	.....	31,163	227,776	301,349	54,155
Delaware: Sussex	368	368	.....	.....	75	.....	2,428	20,480	25,600	4,398
Grand total	268,729	365,373	3,245	46,914	390,645	659,300	2,460,898	8,832,281	12,267,017	2,394,822

[a] Includes the value of 29 lobster pounds amounting to $79,800. Impounded in these in 1913 were 764,572 lobsters, weighing 1,146,857 pounds from Maine waters, and 182,132, weighing 273,198 pounds, from Nova Scotia. The quantity taken out and marketed during the year included 667,326 Maine lobsters, weighing 996,953 pounds, and 160,120 Nova Scotia lobsters, weighing 240,180 pounds.

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For years the lobster fishery as a whole has presented the anomaly of a yearly declining output and a yearly increasing income to the fishermen. Going back 24 years, to 1889, when the Bureau gathered complete statistics of the fishery, it appears that the catch in 1913 showed a decrease of 18,504,556 pounds, or 60 per cent, while the receipts of the fishermen increased $1,533,525, or 178 per cent. What this has meant to the consumer is readily appreciated by everyone who has had occasion to buy lobsters either regularly or occasionally. The variations in the average price per pound received by the fishermen for a series of years beginning with 1880 are shown in the following table, which explains in part why fishermen as a class have been much less solicitous regarding the welfare of the lobster than have other persons. For instance, the lobster fishermen of Maine in 1913 received eleven times as much per pound for their catch as they did in 1880 and nearly two and one-half times as much as in 1900.

AVERAGE PRICE OF LOBSTERS PER POUND FOR MAINE, MASSACHUSETTS, AND THE ENTIRE ATLANTIC COAST IN VARIOUS YEARS FROM 1880 TO 1913.

Year.	Maine.	Massachusetts.	Atlantic coast.
1880	$0.018	$0.036	$0.024
1887	.022	.044	.027
1888	.023	.046	.029
1889	.022	.044	.027
1892	.031	.064	.044
1897[a]	.066	.075	.068
1897	.....	.....	.063
1898	.088	.087	.087
1900	.086	.095	.088
1902	.087	.103	.089
1904	.....	.....	.122
1905	.109	.137	.113
1908	.127	.125	.126
1913	.198	.189	.191

[a] Fiscal year.

Such comparative statistics as are available, representing canvasses made by this Bureau through its field agents, show the tremendous loss which the State of Maine in particular has sustained through failure to place the permanent welfare of all the people of the State above the temporary gain of the fishermen. From the maximum yield obtained in the years 1887, 1888, and 1889, there was a meteoric fall to less than 30 per cent of the average for those three years, while in the last 11 years the decline was nearly 40 per cent. The decrease of the lobster in Massachusetts has been nearly as great as in Maine, but the effect on the general supply has been much less important. Of the two remaining major lobster-producing States, Connecticut appears to have been experiencing a healthy improvement during the past 10 years, although 1913, the best year in that period, produced less than 40 per cent of the yield of 20 years before, while Rhode Island has in recent years had a lobster catch that has been 40 to 50 per cent larger than in any of the earlier years.

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COMPARATIVE STATISTICS OF THE LOBSTER PRODUCT OF THE ATLANTIC COAST STATES FOR VARIOUS YEARS FROM 1880 TO 1913.[a]

Year.	Maine.		New Hampshire.		Massachusetts.		Rhode Island.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
1880	14,234,182	$268,739	250,000	$7,500	4,315,416	$158,229	423,250	$15,871
1887	22,916,642	512,044	142,824	6,268	3,511,075	156,204	570,039	27,128
1888	21,694,731	515,880	136,350	6,256	3,743,475	172,936	588,500	28,047
1889	25,001,351	574,165	137,175	6,415	3,353,787	148,492	456,000	21,565
1890	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
1891	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
1892	17,642,677	663,043	196,350	11,700	3,182,270	205,638	774,100	53,762
1897[c]	10,300,880	683,082	90,300	5,493	2,089,502	157,330	(b)	(b)
1897	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
1898	11,183,294	992,855	108,515	9,372	1,693,741	147,702	578,066	43,290
1900	12,346,450	1,062,206	205,122	19,078	1,805,042	171,825	660,017	58,026
1902	12,163,389	1,066,407	128,463	14,863	1,695,688	175,095	397,305	39,488
1904	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
1905	9,018,759	989,799	256,052	32,575	1,283,071	176,234	529,827	64,358
1908	9,929,000	1,269,000	264,000	43,000	2,455,000	307,000	1,425,000	152,000
1913	7,670,667	1,525,776	301,710	108,360	1,524,389	290,423	1,283,056	197,960

Year.	Connecticut.		New York.		New Jersey.		Delaware.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
1880	613,385	$23,002	135,000	$5,062	156,800	$5,488	150	$6
1887	1,487,020	82,594	114,000	6,850	101,580	7,719	39,000	910
1888	1,477,226	85,723	248,000	13,900	181,688	12,965	39,000	910
1889	1,501,290	83,099	124,023	12,780	188,347	14,301	9,600	480
1890	(b)	(b)	150,400	14,754	185,321	13,683	7,200	360
1891	(b)	(b)	165,093	15,655	165,664	12,463	8,200	410
1892	1,614,530	101,358	(b)	(b)	143,905	10,861	5,600	285
1897[c]	(b)	(b)	130,610	10,913	79,230	6,197	(b)	(b)
1897	(b)	(b)	381,020	31,458	99,230	8,573	5,095	459
1898	1,098,192	83,748	332,378	30,235	123,876	11,097	(b)	(b)
1900	550,450	51,484	156,260	21,224	40,800	6,400	3,600	336
1902	371,650	40,719	(b)	(b)	(b)	(b)	(b)	(b)
1904	(b)	(b)	229,097	27,059	141,340	18,269	2,600	286
1905	436,790	56,141	(b)	(b)	(b)	(b)	(b)	(b)
1908	661,000	84,000	423,000	57,000	115,000	16,000	5,500	800
1913	724,435	131,767	435,811	81,783	301,349	54,155	25,600	4,398

[a] The statistics for 1908 in the above table are from data published by the Bureau of the Census.
[b] Statistics not available.
[c] Fiscal year.

Further evidence of the trend of the lobster fishery is afforded by a consideration of the amount of apparatus required now and formerly to produce a given catch. In all the States more pots are set now than in the earlier years, and the average yield per pot is much less. Going back only as far as 1892, it is seen that the Maine lobstermen then took an average of 115 pounds of lobsters in their 153,000 pots, while in 1913 they obtained only an average of 46 pounds of lobsters in their 167,900 pots. Similar striking comparisons are possible for other States, while, in pleasing contrast, a large increase in the number of traps used by the Rhode Island fishermen has been accompanied by an increased average yield per trap in the preceding 10 years, although one-half the average of 1892 has not been attained.

NEW ENGLAND VESSEL FISHERIES.

The great offshore vessel fisheries centering at the Massachusetts ports of Boston and Gloucester have been covered by the usual

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inquiries of the local agents, and the data collected have been published in monthly and annual bulletins showing by species and fishing grounds the quantities and values of the products landed. This series of bulletins affords an invaluable basis for determining the condition and trend of the New England high-sea fisheries.

In 1914 the fleet landing fish at these two ports numbered 393 sail, steam, and gasoline screw vessels. The number of trips landed at Boston was 3,389, aggregating 92,344,192 pounds of fish, valued at $2,613,987, and at Gloucester 4,209 trips, aggregating 70,245,028 pounds, valued at $1,781,043; a total for both ports of 7,598 trips and 162,589,220 pounds of fish, valued at $4,395,030. Compared with 1913, there was a decrease of 1,231 trips, an increase of 372,434 pounds, and a decrease of $587,987. There was an increase in the yield of cod and haddock, with a decrease in value, and a decrease in both the quantity and value of both hake and pollock. The catch of cusk was not quite so large as in the previous year, but there was a slight increase in the value. The halibut product fell off 1,908,569 pounds in quantity and $183,454 in value. The mackerel catch increased 1,012,848 pounds in quantity and $7,657 in value. Both herring and swordfish showed a decrease. The Newfoundland herring fishery fell off 2,393,979 pounds in quantity and $4,101 in value; the frozen-herring catch was nearly double that of the year previous, but there was a large decrease in salted herring.

The following tables show in detail (1) by fishing grounds and (2) by months the yield of the vessel fisheries out of Boston and Gloucester during the calendar year 1914. The weights of fresh and salted fish given in the tables represent the fish as landed from the vessels, and the values are those received by the fishermen. The grades or sizes given for certain species are those recognized in the trade.

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Quantities and Values of Certain Fishery Products Landed at Boston and Gloucester, Mass., by American Fishing Vessels During the Calendar Year 1914, Shown by Fishing Grounds.

Fishing grounds.	Number of trips.	Cod.											
		Large (10 pounds and over).				Market (under 10 and over 2½ pounds).				Scrod (1 to 2½ pounds).			
		Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
LANDED AT BOSTON.													
East of 66° west longitude.		*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
La Have Bank	20	87,705	$3,276			81,480	$1,670			3,793	$62		
Western Bank	39	134,597	3,773			133,752	2,498			9,508	126		
Quereau Bank	6	18,285	950			4,425	132			200	4		
Grand Bank	4			2,720	$122			1,100	$44				
Off Newfoundland	3												
Cape North	1	14,795	392			41,000	820			7,850	79		
Cape Shore	182	466,432	19,441			485,387	11,161			83,392	1,430		
Gulf of St. Lawrence	3	4,000	120										
St. Anns Bank	1	2,000	65			12,000	180			50	1		
West of 66° west longitude.													
Browns Bank	203	840,424	31,141			1,112,453	22,616			118,895	1,591		
Georges Bank	299	852,287	36,977			552,774	12,823			39,084	679		
Cashes Bank	24	37,036	1,346			65,460	1,360			3,214	55		
Clark Bank	3	18,225	463			23,895	406			1,255	21		
Fippenies Bank	8	10,100	382			19,140	376			565	8		
Tillies Bank	2	270	16			465	27			85	3		
Middle Bank	431	226,433	11,402			532,710	13,779			98,282	1,669		
Jeffreys Ledge	267	120,682	5,731			230,101	5,709			24,588	434		
Ipswich Bay	45	187,455	7,657			72,781	2,179			6,740	132		
South Channel	440	559,122	23,425			1,105,056	23,655			93,376	1,388		
Nantucket Shoals	224	1,107,732	45,841			1,905,150	42,073			121,055	1,578		
Off Highland Light	1	230	10			400	10						
Off Chatham	762	2,830,365	114,039			5,592,628	106,289			359,237	4,972		
Off Race Point	21												
South	2												
Shore, general	398	501,626	18,876			333,294	7,778			41,272	672		
Total	3,389	8,019,801	325,323	2,720	122	12,304,351	255,541	1,100	44	1,012,441	14,904		

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QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., ETC.—Continued.

Fishing grounds.	Number of trips.	Cod.											
		Large (10 pounds and over).				Market (under 10 and over 2½ pounds).				Scrod (1 to 2½ pounds).			
		Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
		Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
LANDED AT GLOUCESTER.													
East of 66° west longitude.													
La Have Bank	28	114,610	$3,065	20,545	$856	168,320	$3,626	16,110	$608	18,160	$140	2,645	$79
Western Bank	78	1,146,531	26,406	212,742	9,202	1,222,975	23,171	240,000	9,061	65,730	554	23,465	705
Quereau Bank	52	606,455	13,748	665,886	26,881	830,800	15,539	786,127	29,729	20,625	155	158,520	4,816
Green Bank	4			10,465	498			1,890	83				
Grand Bank	41	49,660	1,116	1,351,651	55,081	11,415	210	573,852	20,071	125	1	42,365	1,271
St. Peters Bank	3			10,545	469			2,520	96				
Bacalieu Bank	7			47,643	2,019			12,495	458			725	22
Off Newfoundland	37			1,570,120	46,364			732,453	26,798			25,500	765
Cape North	14	349,675	7,987	278,325	11,342	344,500	6,527	409,635	15,454	4,865	36	36,130	1,090
Cape Shore	74	256,260	6,347	92,990	4,164	379,945	7,526	97,295	3,880	42,005	386	15,144	457
Gulf of St. Lawrence	41	149,780	3,407	1,171,079	46,266	28,195	541	130,860	5,361			2,365	71
St. Anns Bank	6	64,576	1,614			142,991	2,860			6,980	53		
The Gully	9	57,445	1,303	48,465	2,351	13,080	230	10,165	438				
Labrador Coast	2			741,197	33,470								
West of 66° west longitude.													
Browns Bank	77	449,634	10,615	26,321	1,185	619,675	12,056	32,845	1,346	78,020	616	8,590	248
Georges Bank	123	299,080	7,427	631,772	31,130	892,750	18,356	520,303	21,806	45,675	355	31,017	934
Cashes Bank	3	1,050	25			7,550	151			1,070	8		
Middle Bank	11												
Jeffreys Ledge	2	645	15			2,430	45			350	3		
Ipswich Bay	157												
South Channel	73	526,165	12,291			1,216,986	25,349			74,965	652		
Nantucket Shoals	174	405,700	9,518	208,205	7,501	2,260,205	44,887	376,685	14,656	159,735	1,193	46,260	1,386
Off Chatham	10												
Bay of Fundy	1												
South	1												
Shore, general	3,181	1,366,092	47,670	4,321	212	200,255	4,044	10,389	443	39,515	316	7,310	219
Total	4,209	5,843,388	152,554	7,092,272	278,991	8,342,072	165,118	3,953,624	150,288	557,820	4,468	400,036	12,063
Grand total	7,598	13,863,189	477,877	7,094,992	279,113	20,646,423	420,659	3,954,724	150,332	1,570,261	19,372	400,036	12,063

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Fishing grounds.	Haddock.						Hake.					
	Large (over 2½ pounds).				Scrod (1 to 2½ pounds).		Large (6 pounds and over).				Small (under 6 pounds).	
	Fresh.		Salted.		Fresh.		Fresh.		Salted.		Fresh.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
LANDED AT BOSTON.												
East of 66° west longitude.												
La Have Bank	510,390	$10,840			29,285	$627	35,680	$1,220			31,335	$722
Western Bank	842,967	15,131			153,775	1,878	16,250	358			17,670	279
Quereau Bank	4,750	226			680	20	10,125	428			1,210	18
Cape North	42,200	1,205			150	2	3,000	60			3,900	29
Cape Shore	2,632,548	86,188			81,533	1,977	241,633	7,941			352,437	6,127
St. Anns Bank	44,000	914			75	2	3,000	73			1,850	13
West of 66° west longitude.												
Browns Bank	6,925,475	176,600			337,516	6,406	114,975	3,732			128,552	2,844
Georges Bank	3,797,215	110,871			738,873	19,160	21,120	729			72,900	1,190
Cashes Bank	25,030	704			1,075	22	97,250	3,178			218,033	3,629
Clark Bank	81,660	1,268			7,640	30						
Fippennies Bank	6,485	131			530	16	31,815	1,126			48,010	913
Tillies Bank	4,595	268			1,465	61	705	46			3,225	131
Middle Bank	2,081,734	80,108			280,001	6,715	259,610	10,165			942,195	18,705
Jeffreys Ledge	422,416	19,322			50,071	1,363	219,039	7,233			472,942	10,077
Ipswich Bay	18,560	923			100	3	1,060	54			2,205	69
South Channel	10,530,890	276,659			3,861,028	59,114	352,753	10,938			830,704	14,107
Nantucket Shoals	243,831	6,401			20,688	507	11,300	283			12,210	186
Off Highland Light	16,940	678			2,470	49	790	47			2,095	55
Off Chatham	12,496,470	292,953			649,544	8,843	404,055	11,863			1,000,241	16,828
Shore, general	256,417	8,311			19,343	416	574,763	17,197			970,659	16,167
Total	40,984,573	1,089,696			6,235,842	107,211	2,398,923	76,671			5,112,273	92,068
LANDED AT GLOUCESTER.												
East of 66° west longitude.												
La Have Bank	263,070	7,320	2,145	$44	10,525	160	766,903	9,980	16,000	$288		
Western Bank	566,910	6,393	4,175	84			1,630,635	21,692	24,495	487		
Quereau Bank	117,795	1,298	19,838	426			139,325	1,886	37,987	701		
Green Bank							7,790	110	3,240	63		
Grand Bank	565	9	14,030	281			138,260	1,837	64,820	1,249		
St. Peters Bank			40	1			13,775	193	1,380	25		

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QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., ETC.—Continued.

Fishing grounds.	Haddock.						Hake.					
	Large (over 2½ pounds).				Scrod (1 to 2½ pounds).		Large (6 pounds and over).				Small (under 6 pounds).	
	Fresh.		Salted.		Fresh.		Fresh.		Salted.		Fresh.	
LANDED AT GLOUCESTER—continued.												
East of 66° west longitude—Continued.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Off Newfoundland			460	$9								
Cape North	2,780	$31	26,345	518			55,855	$779	16,626	$318	1,070	$21
Cape Shore	246,605	4,123	11,955	201	3,370	$25	610,377	8,438	16,397	289	450	8
Gulf of St. Lawrence							14,635	190	15,775	299		
St. Anns Bank	4,520	50					1,070	15				
The Gully	8,635	96					11,885	142	7,935	159		
West of 66° west longitude.												
Browns Bank	2,081,908	27,120	260	5	6,930	45	176,730	2,287	8,495	149		
Georges Bank	2,497,786	28,474	52,297	1,058	70,442	478	60,046	799	7,873	171		
Cashes Bank	2,090	23					22,510	286			3,600	40
Jeffreys Ledge	135	1					10,590	122				
South Channel	1,293,585	14,417			49,580	260	13,520	177			500	10
Nantucket Shoals	211,966	2,421	23,732	455	88,730	488	2,270	30	690	14		
Shore, general	2,846,822	87,908	245	5	3,442	22	1,329,236	20,396	320	6	8,710	87
Total	10,145,172	179,684	155,522	3,087	233,019	1,478	5,005,412	69,359	222,033	4,218	14,330	166
Grand total	51,129,745	1,269,380	155,522	3,087	6,468,861	108,689	7,404,335	146,030	222,033	4,218	5,126,603	92,255

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Fishing grounds.	Pollock.				Cusk.				Halibut.			
	Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
LANDED AT BOSTON.												
East of 66° west longitude.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
La Have Bank	11,106	$298			71,578	$1,216			32,430	$3,481		
Western Bank	21,810	380			45,165	785			102,726	8,607		
Quereau Bank	1,075	42			140	4			28,780	3,095		
Grand Bank									123,000	12,010		
Cape North									69	14		
Cape Shore	39,385	906			422,348	7,137			42,185	5,387		
Gulf of St. Lawrence									140,000	7,000		
St. Anns Bank									48	5		
West of 66° west longitude.												
Browns Bank	76,250	1,797			861,097	13,771			158,887	22,541		
Georges Bank	59,360	1,545			65,717	1,127			51,074	6,988		
Cashes Bank	13,260	318			108,604	1,742			2,372	242		
Clark Bank	2,985	33							1,124	144		
Fippenies Bank	3,010	77			50,705	810			159	24		
Tillies Bank	320	12			230	9			20	5		
Middle Bank	317,728	8,891			383,441	7,389			15,324	2,252		
Jeffreys Ledge	1,076,692	26,287			214,657	4,121			5,805	678		
Ipswich Bay	13,225	382			3,386	68			934	39		
South Channel	347,412	7,183			127,580	1,876			58,138	7,682		
Nantucket Shoals	210,937	3,685			1,790	42			12,787	1,315		
Off Highland Light	260	8			100	3			35	6		
Off Chatham	2,309,029	35,564			61,038	1,005			45,020	6,182		
Shore, general	150,745	2,964			250,970	4,865			5,919	744		
Total	4,655,089	90,372			2,668,546	45,970			826,836	88,441		
LANDED AT GLOUCESTER.												
East of 66° west longitude.												
La Have Bank	26,570	293	8,155	$160	405,470	6,956	10,125	$303	128,847	9,887		
Western Bank	65,900	663	12,977	308	690,932	11,618	18,700	533	328,913	24,750	550	$48
Quereau Bank	11,112	110	12,658	240	49,590	944	15,355	427	312,275	23,438	2,178	218
Green Bank					150	2	112	4	80,874	6,000		
Grand Bank			9,225	183	4,610	78	2,940	83	354,001	23,314	24,923	2,166
St. Peters Bank					40	1	815	25	72,999	5,406		
Bacalieu Bank							35	1	51,915	1,943	206,508	20,647
Cape North	3,015	31	7,535	151	3,585	60	1,085	28	13,825	902	93	8

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QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., ETC.—Continued.

Fishing grounds.	Pollock.				Cusk.				Halibut.			
	Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
LANDED AT GLOUCESTER—continued.												
East of 66° west longitude—Continued.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Cape Shore	42,880	$423	7,505	$135	792,387	$14,058	26,720	$805	193,403	$15,751	965	$97
Gulf of St. Lawrence	1,150	12	635	13	3,840	64	1,175	32	327,826	17,238	74,423	6,257
St. Anns Bank	2,235	22	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
The Gully	315	6	104	2	5,100	90	3,550	89	87,185	7,346	5,615	505
West of 66° west longitude.												
Browns Bank	32,314	305	790	15	622,351	10,954	1,890	57	26,669	2,119	.....	.....
Georges Bank	129,306	1,336	100,402	1,982	237,535	4,101	14,310	402	256,862	19,667	1,330	127
Cashes Bank	255	3	.....	.....	29,400	501	.....	.....	.....	.....	.....	.....
Jeffreys Ledge	.....	.....	.....	.....	11,600	203	.....	.....	.....	.....	.....	.....
South Channel	402,835	4,470	.....	.....	6,682	119	.....	.....	100	12	.....	.....
Nantucket Shoals	300,880	3,234	50,200	1,005	10,225	291	15,125	443	.....	.....	.....	.....
Shore, general	6,569,690	94,242	991	20	205,010	3,537	.....	.....	470	63	.....	.....
Total	7,588,457	105,150	211,177	4,214	3,078,507	53,577	111,937	3,232	2,236,164	157,836	316,585	30,073
Grand total	12,243,546	195,522	211,177	4,214	5,747,053	99,547	111,937	3,232	3,063,000	246,277	316,585	30,073

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Fishing grounds.	Mackerel.											
	Large (over 2½ pounds).				Medium (1½ to 2½ pounds).				Small (under 1½ pounds).			
	Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
LANDED AT BOSTON.												
East of 66° west longitude.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Cape Shore	174,779	$23,984	15,200	$760	170,157	$9,579	.....	.....	78,988	$1,002	.....	.....
West of 66° west longitude.												
Georges Bank	4,655	925	.....	.....	13,599	948	.....	.....	9,030	208	.....	.....
Middle Bank	18,856	3,269	.....	.....	79,175	6,619	.....	.....	196,290	11,595	.....	.....
Jeffreys Ledge	320	102	.....	.....	1,341	241	.....	.....	.....	.....	.....	.....
Ipswich Bay	.....	.....	.....	.....	.....	.....	.....	.....	7,535	919	.....	.....
South Channel	5,456	1,472	.....	.....	9,455	1,574	.....	.....	43,256	885	.....	.....
Nantucket Shoals	88,830	5,106	.....	.....	36,494	2,631	.....	.....	162,945	6,142	.....	.....
Off Chatham	91,069	5,490	.....	.....	102,702	6,932	.....	.....	962,400	35,046	22,400	$1,008
Off Race Point	1,061	285	.....	.....	5,399	618	.....	.....	163,040	9,856	.....	.....
South	11,362	1,261	.....	.....	366	36	.....	.....	.....	.....	.....	.....
Shore, general	51,923	4,003	.....	.....	87,279	4,961	.....	.....	788,516	26,967	1,600	76
Total	448,311	45,897	15,200	760	505,967	34,139	.....	.....	2,412,000	92,620	24,000	1,084
LANDED AT GLOUCESTER.												
East of 66° west longitude.												
Cape Shore	24,600	1,163	405,000	19,949	400	12	.....	.....	.....	.....	.....	.....
Gulf of St. Lawrence	.....	.....	479,800	31,435	.....	.....	8,800	$352	.....	.....	44,400	1,776
West of 66° west longitude.												
Middle Bank	.....	.....	.....	.....	2,200	110	4,900	463	23,960	575	200	12
Ipswich Bay	.....	.....	.....	.....	3,330	281	.....	.....	185,335	5,003	.....	.....
Nantucket Shoals	7,200	536	.....	.....	25,200	1,637	365,200	26,699	20,200	934	587,500	26,881
Off Chatham	400	21	.....	.....	550	17	.....	.....	5,250	110	223,960	10,647
South	2,400	264	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Shore, general	88,866	4,611	.....	.....	136,226	5,853	291,080	26,796	88,000	2,518	258,415	11,570
Total	123,466	6,595	884,800	51,384	167,906	7,910	669,980	54,310	322,745	9,140	1,114,475	50,886
Grand total	571,777	52,492	900,000	52,144	673,873	42,049	669,980	54,310	2,734,745	101,760	1,138,475	51,970

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QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., ETC.—Continued.

Fishing grounds.	Miscellaneous.				Total.				Grand total.	
	Fresh.		Salted.		Fresh.		Salted.			
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
LANDED AT BOSTON.										
East of 66° west longitude.										
La Have Bank	1,688	$61			896,470	$23,473			896,470	$23,473
Western Bank	15,349	341			1,493,569	34,156			1,493,569	34,156
Quereau Bank	1,145	81			70,815	5,000			70,815	5,000
Grand Bank					123,000	12,010	3,820	$166	126,820	12,176
Off Newfoundland	[a] 480,000	11,700	[a] 70,000	$2,100	480,000	11,700	70,000	2,100	550,000	13,800
Cape North	150	9			113,114	2,610			113,114	2,610
Cape Shore	719,993	69,677			5,991,197	251,937	15,200	760	6,006,397	252,697
Gulf of St. Lawrence					144,000	7,120			144,000	7,120
St. Anns Bank					63,023	1,253			63,023	1,253
West of 66° west longitude.										
Browns Bank	80,082	2,094			10,754,606	285,133			10,754,606	285,133
Georges Bank	1,041,745	117,236			7,319,833	311,406			7,319,833	311,406
Cashes Bank	10,480	284			581,814	12,880			581,814	12,880
Clark Bank					136,784	2,365			136,784	2,365
Fippenies Bank	3,116	87			173,635	3,950			173,635	3,950
Tillies Bank	314	17			11,694	595			11,694	595
Middle Bank	200,618	4,604			5,632,397	187,157			5,632,397	187,157
Jeffreys Ledge	67,851	2,102			2,906,505	83,400			2,906,505	83,400
Ipswich Bay	2,028	61			316,009	12,486			316,009	12,486
South Channel	912,372	24,176			18,836,598	454,134			18,836,598	454,134
Nantucket Shoals	103,951	1,278			4,039,700	117,068			4,039,700	117,068
Off Highland Light	1,630	54			24,950	920			24,950	920
Off Chatham	428,785	8,060			27,332,583	654,066	22,400	1,008	27,354,983	655,074
Off Race Point	98,110	1,473			267,610	12,232			267,610	12,232
South Shore, general	476,812	7,608			11,728	1,297			11,728	1,297
					4,509,538	121,529	1,600	76	4,511,138	121,605
Total	4,646,219	251,003	70,000	2,100	92,231,172	2,609,877	113,020	4,110	92,344,192	2,613,987
LANDED AT GLOUCESTER.										
East of 66° west longitude.										
La Have Bank					1,902,475	41,427	75,725	2,338	1,978,200	43,765
Western Bank					5,718,526	115,247	537,104	20,428	6,255,630	135,675
Quereau Bank					2,087,977	57,118	1,698,549	63,438	3,786,526	120,556

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Green Bank					88,814	6,112	15,707	648	104,521	6,760
Grand Bank					558,666	26,565	2,083,806	80,385	2,642,472	106,950
St. Peters Bank					86,814	5,600	15,300	616	102,114	6,216
Bacalieu Bank					51,915	1,943	267,406	23,147	319,321	25,090
Off Newfoundland	[a] 2,955,383	90,242	[a] 5,554,764	101,705	2,955,383	90,242	7,883,297	175,641	10,838,680	265,883
Cape North					779,170	16,374	775,774	28,909	1,554,944	45,283
Cape Shore	3,344	376			2,596,026	58,636	673,971	29,977	3,269,997	88,613
Gulf of St. Lawrence			[a] 210,800	4,743	525,426	21,452	2,140,112	96,605	2,665,538	118,057
St. Anns Bank					222,372	4,614			222,372	4,614
The Gully					183,645	9,213	75,834	3,544	259,479	12,757
Labrador Coast							741,197	33,470	741,197	33,470
West of 66° west longitude.										
Browns Bank					4,094,231	66,117	79,191	3,005	4,173,422	69,122
Georges Bank					4,489,482	80,993	1,359,304	57,610	5,848,786	138,603
Cashes Bank					67,525	1,037			67,525	1,037
Middle Bank	6,200	93			32,360	778	5,100	475	37,460	1,253
Jeffreys Ledge					25,750	389			25,750	389
Ipswich Bay	1,091,225	11,748			1,279,890	17,032			1,279,890	17,032
South Channel	3,170	55			3,588,088	57,812			3,588,088	57,812
Nantucket Shoals					3,492,311	65,169	1,673,597	79,040	5,165,908	144,209
Off Chatham					6,200	148	223,960	10,647	230,160	10,795
Bay of Fundy	3,800	361			3,800	361			3,800	361
South					2,400	264			2,400	264
Shore, general	1,622,243	15,859	[a] 3,200	80	14,504,577	287,126	576,271	39,351	15,080,848	326,477
Total	5,685,365	118,734	5,768,764	106,528	42,343,823	1,031,769	20,901,205	749,274	70,245,028	1,781,043
Grand total	10,331,584	369,737	5,838,764	108,628	141,574,995	3,641,646	21,014,225	753,384	162,589,220	4,395,030

[a] Herring. Other items under "Miscellaneous" include albacore, 200 pounds, value $6; bluebacks, 1,652,350 pounds, value $14,490; butterfish, 46,666 pounds, value $2,384; catfish or wolffish, 132,560 pounds, value $2,214; flounders, 862,585 pounds, value $29,401; herring, 1,474,700 pounds, value $16,643; redfish, 65,704 pounds, value $1,166; shad, 107,760 pounds, value $1,976; sharks, 12,079 pounds, value $228; skates, 45,298 pounds, value $735; sturgeon, 269 pounds, value, $29; swordfish, 1,499,844 pounds, value $177,669; squid, 16,500 pounds, value $165; livers, 831,500 pounds, value $10,547; sounds, 70,505 pounds, value $4,319; spawn, 77,081 pounds, value $5,815; and tongues, 600 pounds, value $8.

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QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., BY AMERICAN FISHING VESSELS DURING THE CALENDAR YEAR 1914, SHOWN BY MONTHS.

Month.	Number of trips.	Cod.											
		Large (10 pounds and over).				Market (under 10 and over 2½ pounds).				Scrod (1 to 2½ pounds).			
		Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
LANDED AT BOSTON.		*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
January	189	323,376	$13,819	.....	.....	400,109	$9,785	.....	.....	84,848	$1,678	.....	.....
February	187	326,584	16,915	.....	.....	354,253	10,662	.....	.....	60,937	1,178	.....	.....
March	264	867,055	36,039	.....	.....	796,871	17,996	.....	.....	84,914	1,473	.....	.....
April	254	743,532	25,533	2,720	$122	910,126	18,092	1,100	$44	87,353	1,342	.....	.....
May	241	955,519	26,411	.....	.....	1,362,068	23,460	.....	.....	102,866	1,567	.....	.....
June	285	1,070,662	36,883	.....	.....	1,694,751	30,912	.....	.....	78,870	1,091	.....	.....
July	371	1,220,335	44,307	.....	.....	1,785,402	32,791	.....	.....	94,728	1,079	.....	.....
August	365	780,245	35,257	.....	.....	1,442,062	27,822	.....	.....	77,387	779	.....	.....
September	346	542,209	29,340	.....	.....	1,428,130	31,005	.....	.....	86,108	1,009	.....	.....
October	383	474,100	28,098	.....	.....	997,589	25,284	.....	.....	98,997	1,364	.....	.....
November	267	284,580	16,552	.....	.....	459,701	12,857	.....	.....	58,362	1,122	.....	.....
December	237	431,604	16,169	.....	.....	673,289	14,875	.....	.....	97,071	1,222	.....	.....
Total	3,389	8,019,801	325,323	2,270	122	12,304,351	255,541	1,100	44	1,012,441	14,904	.....	.....
LANDED AT GLOUCESTER.													
January	369	151,203	6,227	528,394	5,719	26,330	550	76,895	3,152	5,010	38	.....	.....
February	230	88,365	4,368	32,875	1,724	22,935	552	8,760	398	3,155	100	240	$8
March	597	286,845	9,137	75,823	3,802	135,173	2,739	21,710	954	16,940	140	215	6
April	690	1,036,745	26,835	199,885	9,879	543,365	9,710	163,670	5,502	35,070	263	26,445	794
May	299	913,635	21,246	255,002	12,292	754,197	15,508	377,781	15,451	70,018	637	12,405	373
June	237	1,381,052	31,851	1,024,330	42,400	2,112,601	42,475	603,660	23,859	115,175	865	49,415	1,490
July	317	525,086	12,430	1,629,310	65,585	1,751,802	34,281	907,925	32,479	96,165	792	71,550	2,145
August	175	362,167	8,764	184,391	8,019	1,161,690	23,235	566,348	20,870	80,387	599	33,120	986
September	232	422,495	9,718	1,475,750	57,093	940,823	18,109	366,508	13,681	50,230	379	27,696	832
October	124	148,145	3,529	741,328	29,824	302,225	5,768	229,690	9,034	22,645	170	23,610	709
November	645	307,308	11,611	644,095	30,195	253,271	5,075	547,117	21,387	20,815	157	143,425	4,362
December	294	220,342	6,838	301,089	12,459	337,660	7,116	83,560	3,521	42,210	328	11,915	358
Total	4,209	5,843,388	152,554	7,092,272	278,991	8,342,072	165,118	3,953,624	150,288	557,820	4,468	400,036	12,063
Grand total	7,598	13,863,189	477,877	7,094,992	279,113	20,646,423	420,659	3,954,724	150,332	1,570,261	19,372	400,036	12,063
Grounds E. of 66° west longitude	655	3,522,836	93,010	6,224,373	239,085	3,900,265	76,691	3,014,502	112,081	263,283	3,027	306,859	9,276
Grounds W. of 66° west longitude	6,943	10,340,353	384,867	870,619	40,028	16,746,158	343,968	940,222	38,251	1,306,978	16,345	93,177	2,787

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Month.	Haddock.						Hake.					
	Large (over 2½ pounds).				Scrod (1 to 2½ pounds).		Large (6 pounds and over).				Small (under 6 pounds).	
	Fresh.		Salted.		Fresh.		Fresh.		Salted.		Fresh.	
LANDED AT BOSTON.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
January	2,881,870	$114,692	.....	.....	264,391	$8,293	115,214	$5,302	.....	.....	220,548	$6,177
February	3,224,847	129,664	.....	.....	406,337	12,912	61,770	3,638	.....	.....	154,596	5,446
March	6,048,204	151,464	.....	.....	455,247	8,996	55,492	3,003	.....	.....	231,813	6,980
April	3,572,678	61,780	.....	.....	201,508	2,550	159,365	6,382	.....	.....	338,183	6,204
May	2,196,782	50,975	.....	.....	266,706	2,886	208,869	4,416	.....	.....	313,218	3,333
June	2,621,550	54,733	.....	.....	192,853	2,115	196,015	4,142	.....	.....	226,912	3,229
July	3,208,496	54,713	.....	.....	322,135	2,259	196,351	5,297	.....	.....	305,718	5,015
August	3,716,410	65,065	.....	.....	482,834	3,792	220,327	6,759	.....	.....	298,450	5,196
September	4,160,838	92,389	.....	.....	1,005,318	9,883	383,913	11,182	.....	.....	648,697	10,434
October	4,321,778	115,374	.....	.....	1,172,341	17,587	457,202	12,927	.....	.....	1,180,349	17,609
November	2,438,761	107,136	.....	.....	722,332	19,587	228,534	8,897	.....	.....	837,844	14,069
December	2,592,359	91,711	.....	.....	743,840	16,351	115,871	4,726	.....	.....	355,945	7,897
Total	40,984,573	1,089,696	.....	.....	6,235,842	107,211	2,398,923	76,671	.....	.....	5,112,273	92,089
LANDED AT GLOUCESTER.												
January	215,126	9,915	4,850	$97	.....	.....	56,078	2,090	2,655	$54	.....	.....
February	170,561	7,589	450	9	6,465	64	12,840	542	810	17	.....	.....
March	2,222,122	49,128	1,960	40	14,582	180	13,885	573	10,387	207	.....	.....
April	2,163,322	44,899	2,350	47	6,292	34	80,130	937	1,705	34	3,600	40
May	494,028	7,248	8,440	169	18,010	99	405,502	5,482	3,670	73	.....	.....
June	693,695	7,606	37,725	755	103,460	569	525,595	6,859	33,346	649	.....	.....
July	1,009,255	11,202	26,365	508	8,850	49	739,225	9,663	44,800	898	1,070	21
August	1,279,413	14,280	19,052	381	67,000	437	978,585	12,499	15,750	314	500	10
September	1,104,276	12,211	28,842	646	980	5	1,106,960	14,866	39,412	741	.....	.....
October	428,573	4,715	9,745	182	2,305	13	804,328	10,887	35,208	629	9,160	95
November	177,415	5,162	9,448	143	1,145	6	125,615	1,706	10,425	183	.....	.....
December	187,386	5,729	6,295	110	3,930	22	156,669	3,255	23,865	419	.....	.....
Total	10,145,172	179,684	155,522	3,087	233,019	1,478	5,005,412	69,359	222,033	4,218	14,330	166
Grand total	51,129,745	1,269,380	155,522	3,087	6,468,861	108,689	7,404,335	146,030	222,033	4,218	5,126,603	92,255
Grounds E. of 66° west longitude	5,287,735	133,824	78,988	1,564	279,393	4,691	3,700,198	55,342	204,655	3,878	409,922	7,217
Grounds W. of 66° west longitude	45,842,010	1,135,556	76,534	1,523	6,189,468	103,998	3,704,137	90,688	17,378	340	4,716,681	85,038

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QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., ETC.—Continued.

Month.	Pollock.				Cusk.				Halibut.			
	Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
LANDED AT BOSTON.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
January	92,804	$2,873	.....	.....	210,242	$4,179	.....	.....	35,957	$6,613	.....	.....
February	80,811	3,408	.....	.....	188,040	4,143	.....	.....	32,560	5,560	.....	.....
March	123,173	3,847	.....	.....	417,583	7,794	.....	.....	162,721	18,053	.....	.....
April	144,496	3,988	.....	.....	497,463	7,581	.....	.....	81,118	9,194	.....	.....
May	205,638	3,100	.....	.....	150,865	2,547	.....	.....	126,417	12,033	.....	.....
June	536,990	7,150	.....	.....	65,700	1,237	.....	.....	198,112	12,298	.....	.....
July	938,892	11,555	.....	.....	26,008	503	.....	.....	49,265	3,565	.....	.....
August	914,152	14,540	.....	.....	112,238	1,888	.....	.....	24,043	2,947	.....	.....
September	605,894	16,461	.....	.....	180,535	3,133	.....	.....	34,465	4,121	.....	.....
October	582,383	13,618	.....	.....	266,459	4,540	.....	.....	26,483	3,931	.....	.....
November	208,293	3,631	.....	.....	202,722	3,445	.....	.....	17,416	3,781	.....	.....
December	221,563	6,201	.....	.....	350,691	4,980	.....	.....	38,279	6,345	.....	.....
Total	4,655,089	90,372	.....	.....	2,668,546	45,970	.....	.....	826,836	88,441	.....	.....
LANDED AT GLOUCESTER.												
January	358,613	11,278	.....	.....	35,725	691	2,700	$68	32,128	2,835	.....	.....
February	112,477	5,042	1,350	$27	6,520	137	1,710	43	47,708	2,989	.....	.....
March	62,523	2,096	809	16	81,035	1,346	5,015	105	252,840	19,086	7,720	$694
April	203,241	5,698	1,892	38	166,132	2,913	685	17	229,307	17,625	3,767	372
May	592,877	5,829	11,776	225	252,910	4,525	3,625	81	148,686	10,657	4,009	381
June	439,734	4,606	46,845	938	150,507	2,537	5,835	148	349,292	19,385	42,181	3,573
July	704,113	7,821	51,240	1,116	370,250	6,163	28,785	863	415,003	26,849	48,727	4,039
August	172,695	1,835	32,272	647	419,835	6,709	8,825	264	212,188	13,227	395	35
September	119,578	1,163	33,740	617	741,772	13,224	21,060	630	236,695	17,865	202,038	20,204
October	37,460	372	17,890	356	532,471	9,552	12,037	359	218,771	17,691	6,500	650
November	3,939,710	46,428	7,808	137	81,115	1,460	15,450	467	63,946	6,317	1,203	120
December	845,436	12,982	5,555	97	240,235	4,320	6,210	187	29,600	3,310	45	5
Total	7,588,457	105,150	211,177	4,214	3,078,507	53,577	111,937	3,232	2,236,164	157,836	316,585	30,073
Grand total	12,243,546	195,522	211,177	4,214	5,747,053	99,547	111,937	3,232	3,063,000	246,277	316,585	30,073
Grounds E. of 66° west longitude	226,553	3,186	58,794	1,192	2,494,935	43,013	80,612	2,330	2,421,301	175,574	315,255	29,946
Grounds W. of 66° west longitude	12,016,993	192,336	152,383	3,022	3,252,118	56,534	31,325	902	641,699	70,703	1,330	127

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Month.	Mackerel.											
	Large (over 2½ pounds).				Medium (1½ to 2½ pounds).				Small (under 1½ pounds).			
	Fresh.		Salted.		Fresh.		Salted.		Fresh.		Salted.	
LANDED AT BOSTON.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
May	11,125	$1,224			170	$17						
June	238,260	26,657	15,200	$760	187,835	10,602			281,816	$5,427		
July	84,185	7,463			91,217	5,962			1,048,131	27,168	24,000	$1,084
August	83,961	5,158			175,302	11,683			917,093	46,650		
September	902	269			4,319	496			127,336	8,067		
October	1,727	442			6,077	849			37,200	5,284		
November	26,080	4,038			38,972	4,062			384	19		
December	2,071	646			2,075	448			40	5		
Total	448,311	45,897	15,200	760	505,967	34,139			2,412,000	92,620	24,000	1,084
LANDED AT GLOUCESTER.												
May	2,400	264										
June	27,700	1,292	375,400	18,617	2,050	62			35,580	1,061	4,360	208
July	7,200	536	29,600	1,332	6,400	462			283,705	7,847	1,064,400	48,791
August					70,820	3,459	548,600	$42,925				
September					10,300	1,106	111,580	10,943	3,060	184		
October	14,925	1,192	378,400	25,159	2,914	187	1,000	90	400	48	45,715	1,892
November	68,664	3,096	101,400	6,276	73,203	2,457	8,800	352				
December	2,577	215			2,219	177						
Total	123,466	6,595	884,800	51,384	167,906	7,910	669,980	54,310	322,745	9,140	1,114,475	50,886
Grand total	571,777	52,492	900,000	52,144	673,873	42,049	669,980	54,310	2,734,745	101,760	1,138,475	51,970
Grounds E. of 66° west longitude	199,379	25,147	900,000	52,144	170,557	9,591	8,800	352	78,988	1,002	44,400	1,776
Grounds W. of 66° west longitude	372,398	27,345			503,316	32,458	661,180	53,958	2,655,757	100,758	1,094,075	50,194

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QUANTITIES AND VALUES OF CERTAIN FISHERY PRODUCTS LANDED AT BOSTON AND GLOUCESTER, MASS., ETC.—Continued.

Month.	Miscellaneous.[a]				Total.				Grand total.	
	Fresh.		Salted.		Fresh.		Salted.			
LANDED AT BOSTON.	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
January	271,100	$8,547			4,900,459	$181,958			4,900,459	$181,958
February	354,958	10,686			5,245,693	204,212			5,245,693	204,212
March	191,582	7,326			9,434,655	262,971			9,434,655	262,971
April	66,929	1,583			6,802,751	144,229	3,820	$166	6,806,571	144,395
May	192,384	2,619			6,092,627	135,088			6,092,627	135,088
June	366,092	18,252	70,000	$2,100	7,956,418	214,728	85,200	2,860	8,041,618	217,588
July	717,936	69,837			10,088,799	271,514	24,000	1,084	10,112,799	272,598
August	566,338	53,124			9,810,842	280,660			9,810,842	280,660
September	685,806	41,157			9,894,470	258,946			9,894,470	258,946
October	638,576	20,142			10,261,261	267,049			10,261,261	267,049
November	322,703	8,950			5,846,684	208,166			5,846,684	208,166
December	271,815	8,780			5,896,513	180,356			5,896,513	180,356
Total	4,646,219	251,003	70,000	2,100	92,231,172	2,609,877	113,020	4,110	92,344,192	2,613,987
LANDED AT GLOUCESTER.										
January	2,535,750	77,654	1,687,600	31,497	3,415,963	111,278	2,303,094	40,587	5,719,057	151,865
February	181,175	5,740	22,200	500	652,201	27,123	68,395	2,726	720,596	29,849
March	14,758	807			3,100,703	85,232	123,639	5,824	3,224,342	91,056
April					4,467,204	108,954	400,399	16,683	4,867,603	125,637
May	144,000	1,728			3,796,263	73,223	676,708	29,045	4,472,971	102,268
June	682,000	6,433	588,000	14,173	6,618,441	125,601	2,811,097	106,805	9,429,538	232,406
July	476,025	4,191	84,800	2,120	6,394,149	122,307	3,987,502	159,876	10,381,651	282,183
August	131,814	1,739	31,400	942	4,937,094	86,793	1,440,153	75,383	6,377,247	162,176
September	1,014,800	10,008	5,800	145	5,751,969	98,838	2,312,426	105,532	8,064,395	204,370
October	245,700	2,586			2,770,022	56,805	1,501,123	68,884	4,271,145	125,689
November	2,210	135	1,272,748	21,181	5,114,417	83,610	2,761,919	84,803	7,876,336	168,413
December	257,133	7,713	2,076,216	35,970	2,325,397	52,005	2,514,750	53,126	4,840,147	105,131
Total	5,685,365	118,734	5,768,764	106,528	49,343,823	1,031,769	20,901,205	749,274	70,245,028	1,781,043
Grand total	10,331,584	369,737	5,838,764	108,628	141,574,995	3,641,646	21,014,225	753,384	162,589,220	4,395,030
Grounds E. of 66° west longitude	4,177,052	172,487	5,835,564	108,548	27,132,397	903,802	17,072,802	562,172	44,205,199	1,365,974
Grounds W. of 66° west longitude	6,154,532	197,250	3,200	80	114,442,598	2,837,844	3,941,423	191,212	118,384,021	3,029,056

[a] Includes herring from Newfoundland, 3,435,383 pounds frozen, $101,942, and 5,624,764 pounds salted, $103,805.

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Nearly three-fourths of the fish landed by American fishing vessels at Boston and Gloucester, Mass., in 1914, or 72.81 per cent of the quantity and 68.92 per cent of the value, were from fishing grounds lying directly off the coast of the United States; 9.03 per cent of the quantity and 9.94 per cent of the value from fishing banks off the coast of Newfoundland; 17.70 per cent of the quantity and 20.37 per cent of the value from grounds off the Canadian Provinces; and less than 1 per cent of both quantity and quality from the coast of Labrador. Newfoundland herring constituted 5.57 per cent of the quantity and 4.68 per cent of the value of the products landed by the fishing fleet at these ports during the year. The herring were taken on the treaty coast of Newfoundland, but cod and other species from that region were obtained chiefly from fishing banks on the high seas. All the fish caught by American fishing vessels off the Canadian Provinces were from offshore fishing grounds. The catch from each of these fishing regions is given in detail in the following table:

QUANTITY AND VALUE OF FISH LANDED BY AMERICAN FISHING VESSELS AT BOSTON AND GLOUCESTER, MASS., IN 1914, FROM GROUNDS OFF THE COAST OF THE UNITED STATES, NEWFOUNDLAND, AND CANADIAN PROVINCES.

Species.	United States.		Newfoundland.[a]		Canadian Provinces.		Total.	
	Pounds.	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*	*Pounds.*	*Value.*
Cod:								
Fresh	28,393,489	$745,180	61,230	$1,327	7,625,154	$171,401	36,079,873	$917,908
Salted	1,904,018	81,066	5,127,241	187,631	4,418,493	172,811	11,449,752	441,508
Haddock:								
Fresh	52,031,478	1,239,554	565	9	5,566,563	138,506	57,598,606	1,378,069
Salted	76,534	1,523	14,530	291	64,458	1,273	155,522	3,087
Hake:								
Fresh	8,420,818	175,726	159,825	2,140	3,950,295	60,419	12,530,938	238,285
Salted	17,378	340	69,440	1,337	135,215	2,541	222,033	4,218
Pollock:								
Fresh	12,016,993	192,336	.....	.....	226,553	3,186	12,243,546	195,522
Salted	152,383	3,022	9,225	183	49,569	1,009	211,177	4,214
Cusk:								
Fresh	3,252,118	56,534	4,800	81	2,490,135	42,932	5,747,053	99,547
Salted	31,325	902	3,902	113	76,710	2,217	111,937	3,232
Halibut:								
Fresh	641,699	70,703	682,789	48,673	1,738,512	126,901	3,063,000	246,277
Salted	1,330	127	231,431	22,813	83,824	7,133	316,585	30,073
Mackerel:								
Fresh	3,531,471	160,561	.....	.....	448,924	35,740	3,980,395	196,301
Salted	1,755,255	104,152	.....	.....	953,200	54,272	2,708,455	158,424
Herring:								
Fresh	1,474,700	16,643	3,435,383	101,942	.....	.....	4,910,083	118,585
Salted	3,200	80	5,624,764	103,805	210,800	4,743	5,838,764	108,628
Swordfish:								
Fresh	868,264	109,300	.....	.....	631,580	68,369	1,499,844	177,669
Miscellaneous								
Fresh	3,811,568	71,307	.....	.....	110,089	2,176	3,921,657	73,483
Total	118,384,021	3,029,056	15,425,125	470,345	28,780,074	895,629	162,589,220	4,395,030

[a] Includes 741,197 pounds of salted cod, valued at $33,470, from the Labrador coast.

THE GROUND-FISH FISHERIES.

Cod.—In 1914 there were landed at Boston and Gloucester 47,529,625 pounds of cod, of which 36,079,873 pounds were fresh and 11,449,752 pounds salted, valued at $1,329,416; an increase of 6,902,642 pounds of fresh over the amount landed in 1913, but a decrease of 4,237,830 pounds in the quantity of the salted product, and a decrease of $245,459 in the total value.

Vessels using hand lines baited with cockles, fishing on Nantucket Shoals and South Channel, in 1914 had the best year for cod, it is

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reported in the history of the fishery. In May and June, 1915, the drift hand-line fisherman landed good fares from the same grounds, but as in 1914 there was a scarcity of fish on Georges Bank, and only a few fish were taken there by vessels fitted with trawl lines and hand lines.

Haddock.—The haddock fishery in 1914 was carried on with success, the product being 57,754,128 pounds, valued at $1,381,156, against 53,672,665 pounds, valued at $1,488,356, in 1913, an increase of over 4,000,000 pounds, but a decrease of $107,200. The principal banks resorted to were Browns, Georges, South Channel, and the grounds off Chatham, although considerable fishing was done on Middle Bank and other shore grounds. The amount of haddock caught on Georges Bank and in South Channel was over 8,000,000 pounds less than in 1913, but the catch on Browns was nearly 3,200,000 pounds greater, and there was an increase of 10,800,000 pounds from the shore grounds off Chatham. Vessels visiting the Chatham grounds in summer fish night and day, weather permitting, and the pleasant weather prevailing the greater part of this period in 1914 no doubt accounted for the remarkable increase in the catch.

Pollock.—The pollock fishery, owing to the introduction of purse seines, has in recent years been conducted on a much larger scale than formerly. Although a considerable quantity of pollock is caught by trawlers and hand-line fishermen on the offshore banks, a large portion of the fresh product landed is caught in purse seines operated from small steamers and gasoline boats on the inshore grounds. In 1914 the quantity of pollock landed at Boston and Gloucester was 12,454,723 pounds, valued at $199,736. Compared with 1913 the catch fell short 2,812,678 pounds in quantity and $61,821 in value. The pollock-seining fleet in May and June, 1915, brought in many large fares. These vessels catch also other fish in their season, among which are alewives or bluebacks, which are used chiefly for bait in the line-trawl market fishery. In 1914 the blueback catch amounted to 1,652,350 pounds, 8,250 pounds less than in 1913 and over 600,000 pounds less than in 1912.

Halibut.—There was a decrease in the catch of halibut on the Atlantic coast in 1914 of nearly 2,000,000 pounds as compared with the previous year. In the spring of 1915 several large fares of halibut were taken on various banks, which led to an increase in the fleet, and in April there were 33 vessels engaged in this fishery. The fletched halibut-fleet fishing in northern regions, namely, Greenland and Davis Strait, has greatly decreased in the last few years, only two vessels having sailed for those grounds last season.

During a part of the year the Coast Guard steamer *Androscoggin*, recently converted into a hospital ship, has rendered excellent service in caring for the sick fishermen on the fishing banks. Medical aid has been given to Canadian as well as to American fishermen.

THE OTTER-TRAWL FISHERY.

The investigation of the otter-trawl fishery, which had been in progress since June, 1912, was brought to a close by the submittal of a final report thereon in January, 1915. This report, the work of a special committee of Bureau officials, was forwarded to Congress on January 22, referred to the House Committee on the Merchant Marine

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and Fisheries on January 25, and ordered to be printed (H. Doc. No. 1519, 63d Cong., 3d sess.). The committee examined a very large amount of material for American and European fisheries, and reached unanimous conclusions which were accepted as the official views of the Bureau. The findings of the committee with reference to the major questions to which the fishery has given rise in American waters are as follows:

1. There is no evidence that the banks resorted to by American otter trawlers are being depleted of their fishes.

2. Otter trawling does not destroy the spawn of the important commercial fishes, all of which have floating eggs.

3. Otter trawling does not injuriously affect the bottom and does not denude it of organisms which directly or indirectly serve as food for the commercial fishes.

4. From the very nature of the two fisheries, otter trawling and line fishing can not be extensively prosecuted on the same grounds without accidental damage to lines and interference with line fishing, but in the period covered by the investigation only slight interference or damage occurred.

5. Otter trawls as compared with lines take a much larger percentage of commercial fishes too small to market, and such fishes are practically all destroyed.

6. Otter-trawl vessels as compared with trawl-line vessels market a much larger proportion of small fish.

The findings of the committee as to the effects of otter trawling are necessarily inconclusive because of the short time that has elapsed since the establishment of the fishery and because of the small number of vessels engaged. The vital consideration being the safeguarding of the food-fish supply of coming generations rather than the immediate and demonstrable effects on that supply of particular kinds of apparatus or methods, the committee believe that the otter-trawl fishery should be kept under careful observation and should be so regulated as to obviate in American waters the conditions that have arisen in the North Sea from an excessive use of otter trawls.

The measure which is regarded as the most just, reasonable, and feasible to prevent an undue development of the New England otter-trawl fishery is to restrict it to the regions to which it has up to this time practically been confined and on which its effects will be most immediately and most unmistakably manifested, namely, George Bank, South Channel, and part of Nantucket Shoals. This course will retain to the otter trawlers sufficiently extensive grounds, it will not exclude line fishermen therefrom, and will reserve to the latter's exclusive use the grounds from which they take over two-thirds of their trips.

This fishery was conducted on the same grounds as in 1913, namely, Georges, South Channel, and Western Bank, and nine vessels were regularly engaged. The fishery was carried on chiefly from Boston as heretofore, although during a portion of the year two vessels belonging to New York operated out of that port, and several vessels have begun to discharge their fares regularly at Portland.

The amount of fish landed at Boston by otter trawlers in 1914 was 16,921,295 pounds, an increase of 1,747,985 pounds over the previous year. The total number of trips brought in was 376, an

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increase of 50, of which there were landed from Georges 64 trips, from South Channel 272, and from Western Bank 40. This fleet also marketed at Portland 5,830,603 pounds of fish, a large portion of which was taken on Western Bank during the spring months.

The principal species taken by otter trawlers is haddock, although cod, cusk, and hake are sometimes caught in considerable quantities, especially cod. In 1914 the amount of haddock landed at Boston by otter trawlers was 14,832,950 pounds, exceeding that of the preceding year by 2,254,518 pounds. Of the total catch of this species in 1913 the quantity of scrod amounted to 2,144,062 pounds, and in 1914 to 4,176,950 pounds.

On June 16, 1915, the otter trawler *Long Island* landed at Portland 280,000 pounds of fish, and on July 1 the same vessel brought in a fare of 300,000 pounds. These are the largest fares ever taken by an American otter trawler.

THE MACKEREL FISHERY.

The catch of fresh and salted mackerel in 1914 exceeded that of the previous year by 27,139 barrels, made up of 19,427 barrels fresh and 7,712 salted. The yield on the Cape Shore and in the Gulf of St. Lawrence was 4,961 barrels, an increase of 3,017 barrels over 1913. The southern mackerel fishery in the spring of 1915 showed an improvement over 1914, the highest stock made by a single vessel up to the end of May was $8,885, which is said to be the largest made in the southern fishery since 1907. The southern fleet consisted of 42 vessels, 25 seiners and 17 netters, sailing from Boston, Gloucester, and Rockport, Mass. The first trip of mackerel was captured about 100 miles east by south from Cape Henlopen and landed at Lewes, Del., on April 9, and the first mackerel landed at Boston and Gloucester from the Cape Shore was on June 7, immediately followed by the arrival of 10 other vessels from that region. They reported many schools of fish off the coast of Nova Scotia, between Liverpool and Halifax. By the end of the month several of the Cape Shore fleet had landed two trips from that ground, and one vessel reported to be on her third trip. It is seldom that a second trip of mackerel is secured on the Cape Shore in the early part of the season. At this time there was also a considerable body of mackerel off Block Island and in the vicinity of Nantucket Shoals, frequent fares being landed at Newport and Boston from those grounds. As was the case in the early part of the mackerel season of 1914, a large quantity of small fish was taken along the coast from Cape Cod to the Gulf of Maine.

THE SWORDFISH FISHERY.

Swordfish were less plentiful in 1914 than for several years. The quantity landed at Boston and Gloucester by American fishing vessels was 1,499,844 pounds fresh, valued at $177,669, being 881,076 pounds and $18,208 less than in 1913. In the last few years a considerable fleet of Canadian vessels has been engaged in catching swordfish out of Nova Scotia ports, and much of this catch is shipped to the United States. The foreign receipts of swordfish at Boston in 1914 amounted to 4,555 fish, or 144 fish less than were received in 1913.

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The first swordfish landed at Boston in 1915 was on June 21 by two vessels, one having 26 and the other 33 fish, for which the fishermen received 15 and 20 cents a pound. From June 23 to the end of the month 344 fish were brought in, the catch of seven vessels. The first swordfish landed last season was on June 15.

THE NEW ENGLAND WINTER GILL-NET FISHERY.

Thirty-eight vessels were employed in the winter gill-net fishery at Gloucester, and there was also a small fleet that fished out of Portland, Me. In the early part of the season the catch was mainly cod and pollock, chiefly the latter species, and few haddock were taken until the latter part of March. Owing to the general scarcity of fish on the inshore grounds only a few vessels were successful, and early in May many vessels of the fleet had transferred to the mackerel fishery.

NEWFOUNDLAND SEAL AND HERRING FISHERIES.

During March and April the schooner *John R. Bradley* of Gloucester was engaged in taking seals off the coast of Newfoundland, which is believed to be the first American vessel to take part in this fishery. Her catch amounted to only 235 skins. The Newfoundland fleet, consisting of about 20 steamers and a few sailing vessels, also met with poor success.

The Newfoundland herring landed at Boston, Gloucester, and other New England ports during the season of 1914–15 amounted to approximately 2,570,352 pounds fresh frozen, and 49,166 barrels, or 11,071,584 pounds, salted. The fleet bringing in these fish included about 27 American and 15 Canadian vessels.

FRESH-WATER MUSSEL FISHERY.

In the course of the general canvass of the fresh-water mussel fishery which has been in progress for several years, the streams covered in 1914 were those tributary to the Great Lakes and the Ohio and Mississippi Rivers north of the Ohio and east of the Mississippi, except tributaries of the Ohio River in Ohio, which were included in the work of the previous year. The data collected were for the calendar year 1913, and the details of the industry are shown by streams in the accompanying table. The number of persons engaged in taking mussels in the streams under consideration and in preparing them for market was 3,592, and the investment in boats, fishing apparatus, and shore and accessory property amounted to $166,855. The output included 23,317 tons of shells, valued at $382,210, and pearls worth $164,261 found in the mussels, a total of $546,471. The shells are used in the manufacture of pearl buttons. The principal fishing apparatus employed in this fishery is the crowfoot bar. The most important stream in the region canvassed is Rock River, the output of which in shells and pearls was worth $150,696. The Illinois River ranks next in importance, with a yield of shells and pearls valued at $128,692. These two rivers furnished over 51 per cent of the total product.

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FRESH-WATER MUSSEL FISHERY OF STREAMS TRIBUTARY TO THE GREAT LAKES AND THE OHIO AND MISSISSIPPI RIVERS NORTH OF THE OHIO AND EAST OF THE MISSISSIPPI RIVER IN 1913.[a]

NOTE.—In the case of men working on more than one stream the catch is credited where taken, but the men, boats, and apparatus are shown under the more important stream.

Item.	Eel River, Ind.		Embarras River, Ill.		Fox River, Wis. and Ill.		Grand River, Mich.		Huron and Raisin Rivers, Mich.		Illinois River, Ill.		Iroquois River, Ill.		Kalamazoo River and minor tributary, Mich.		Kankakee River, Ind., and Ill.	
	No.	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*
Persons engaged:																		
Fishermen	24	.....	12	.....	122	.....	42	.....	15	.....	861	.....	12	.....	48	.....	57	.....
Shoresmen	.....	.....	.....	.....	14	.....	3	.....	1	.....	103	.....	.....	.....	1	.....	.....	.....
Total	24	.....	12	.....	136	.....	45	.....	16	.....	964	.....	12	.....	49	.....	57	.....
Fishermen, classified by method used:																		
Crowfoot bars	.....	.....	.....	.....	34	.....	39	.....	6	.....	721	.....	.....	.....	39	.....	41	.....
Forks	8	.....	.....	.....	2	.....	31	.....	.....	.....	5	.....	.....	.....	8	.....	35	.....
Tongs	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5	.....
Rakes	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10	.....	.....	.....
Diggers or dip nets	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	140	.....	.....	.....	.....	.....	.....	.....
Waders	24	.....	12	.....	108	.....	.....	.....	9	.....	36	.....	12	.....	30	.....	46	.....
Total, exclusive of duplication	24	.....	12	.....	122	.....	42	.....	15	.....	861	.....	12	.....	48	.....	57	.....
Boats:																		
Rowboats	24	$200	12	$70	84	$665	43	$300	20	$150	286	$2,235	12	$75	47	$380	54	$445
Gasoline boats	.....	.....	.....	.....	6	575	5	450	.....	.....	504	41,210	.....	.....	6	410	4	350
House boats	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	77	10,735	.....	.....	2	200	1	200
Total	24	200	12	70	90	1,240	48	750	20	150	867	54,180	12	75	55	990	59	995
Apparatus:																		
Crowfoot bars.....pairs	.....	.....	.....	.....	34	355	39	395	.....	.....	721	7,080	.....	.....	39	410	41	445
Forks	8	9	.....	.....	2	2	31	36	6	8	5	6	.....	.....	8	10	17	20
Tongs	2	10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5	25
Rakes	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10	15	.....	.....
Diggers or dip nets	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	102	658	.....	.....	.....	.....	.....	.....
Total	.....	19	.....	.....	.....	357	.....	431	.....	8	.....	7,744	.....	.....	.....	435	.....	490
Shore and accessory property	.....	50	.....	45	.....	270	.....	220	.....	30	.....	4,585	.....	50	.....	140	.....	245
Total investment	.....	269	.....	115	.....	1,867	.....	1,401	.....	188	.....	66,509	.....	125	.....	1,565	.....	1,730

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PRODUCTS.																		
Shells:																		
With crowfoot bars	tons					260	5,370	324	5,572			4,046	58,252			157	4,841	78	1,860
With forks	do	15	220			4	104	56	985	23	401	15	225			15	465	76	1,885
With tongs	do	6	111															6	145
With rakes	do															30	836		
With diggers or dip nets	do											1,733	28,200						
With hands	do	70	1,010	78	1,377	89	2,323			33	660	96	1,400	100	1,850	22	682	42	1,030
Total		91	1,341	78	1,377	353	7,797	380	6,557	56	1,061	5,890	88,077	100	1,850	224	6,824	202	4,920
Pearls			460		345		8,045		2,250		445		40,615		1,560		2,665		2,290
Total value of products			1,801		1,722		15,842		8,807		1,506		128,692		3,410		9,489		7,210

a This does not include tributaries of the Ohio River in Ohio, data for which were shown in Statistical Bulletin No. 305.

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FRESH-WATER MUSSEL FISHERY OF STREAMS TRIBUTARY TO THE GREAT LAKES AND THE OHIO AND MISSISSIPPI RIVERS NORTH OF THE OHIO AND EAST OF THE MISSISSIPPI RIVER IN 1913—Continued.

Item.	Little Wabash and minor tributary, Ill.		Maple River, Mich.		Maumee River and tributaries, Ohio and Ind.		Mississinewa River, Ind.		Muskegon River, Mich.		Okaw or Kaskaskia River, Ill.		Pecatonica River, Wis. and Ill.		Rock River and minor tributaries, Wis. and Ill.		St. Croix River and minor tributaries, Minn. and Wis.	
	No.	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*
Persons engaged:																		
Fishermen	29		9		13		27		11		83		49		500		185	
Shoresmen													3		94		17	
Total	29		9		13		27		11		83		52		594		202	
Fishermen, classified by methods used:																		
Crowfoot bars			6						11				49		442		120	
Forks	25		6		11		15		7		58				33			
Tongs											4						2	
Rakes															38		40	
Dredges																	63	
Waders	4		6		2		27				83				63		28	
Total, exclusive of duplication	29		9		13		27		11		83		49		500		185	
Boats:																		
Rowboats	27	$135	9	$75	8	$40	21	$135	11	$90	74	$370	22	$150	242	$1,626	153	$1,175
Gasoline boats									2	185			25	2,300	229	16,190	34	2,860
House boats															3	400		
Total	27	135	9	75	8	40	21	135	13	275	74	370	47	2,450	474	18,216	187	4,035
Apparatus:																		
Crowfoot bars.....pairs			6	60					11	100			49	524	433	4,594	120	1,200
Forks	25	30	6	10	11	21	15	30	7	10	58	81			31	41		
Tongs											4	25					2	13
Rakes															38	50	32	45
Dredges																	36	63
Total		30		70		21		30		110		106		524		4,685		1,321
Shore and accessory property		105		25		80		80		110		505		660		5,580		1,185
Total investment		270		170		141		245		495		981		3,634		28,481		6,541

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PRODUCTS.																		
Shells:																		
With crowfoot bars.....tons..			50	750					40	790			617	10,678	7,197	115,032	419	7,956
With forks.....do....	205	2,445	15	225	101	2,263	90	1,890	15	270	744	11,515	.....	.....	153	2,525	.....	.....
With tongs.....do....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	20	240	.....	.....	.....	.....	13	260
With rakes.....do....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	48	792	69	1,023
With dredges.....do....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	225	4,500
With hands.....do....	4	34	9	135	.....	.....	51	1,005	.....	.....	463	6,290	.....	.....	22	418	9	133
Total.....	209	2,479	74	1,110	101	2,263	141	2,895	55	1,060	1,227	18,045	617	10,678	7,420	118,767	735	13,872
Pearls.....	.....	1,040	.....	850	.....	210	.....	1,025	.....	500	.....	5,925	.....	785	.....	31,929	.....	23,160
Total value of products.....	.....	3,519	.....	1,960	.....	2,473	.....	3,920	.....	1,560	.....	23,970	.....	11,463	.....	150,696	.....	37,032

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FRESH-WATER MUSSEL FISHERY OF STREAMS TRIBUTARY TO THE GREAT LAKES AND THE OHIO AND MISSISSIPPI RIVERS NORTH OF THE OHIO AND EAST OF THE MISSISSIPPI RIVER IN 1913—Continued.

Item.	St. Joseph River and minor tributary, Ind. and Mich.		Sangamon River, Ill.		Wabash River and minor tributary, Ind. and Ill.		White River, Ind.		White River, East Fork, Ind.		White River, West Fork, Ind.		Miscellaneous rivers, Wis.[a]		Total.	
	No.	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*	*No.*	*Value.*
Persons engaged:																
Fishermen	41	.....	41	.....	677	.....	35	.....	405	.....	17	.....	22	.....	[b] 3,337	.....
Shoresmen	1	.....	.....	.....	6	.....	1	.....	11	.....	.....	.....	.....	.....	[c] 255	.....
Total	42	.....	41	.....	683	.....	36	.....	416	.....	17	.....	22	.....	3,592	.....
Fishermen, classified by methods used:																
Crowfoot bars	26	.....	.....	.....	564	.....	7	.....	109	.....	.....	.....	13	.....	2,216	.....
Forks	1	.....	4	.....	454	.....	23	.....	374	.....	9	.....	7	.....	1,116	.....
Tongs	.....	.....	.....	.....	207	.....	24	.....	269	.....	.....	.....	.....	.....	513	.....
Rakes	.....	.....	.....	.....	3	.....	.....	.....	.....	.....	.....	.....	2	.....	93	.....
Diggers or dip nets	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	140	.....
Dredges	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	63	.....
Miscellaneous apparatus	12	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	13	.....
Waders	3	.....	41	.....	41	.....	32	.....	313	.....	17	.....	7	.....	944	.....
Total, exclusive of duplication	41	.....	41	.....	677	.....	35	.....	405	.....	17	.....	22	.....	3,337	.....
Boats:																
Rowboats	37	$255	19	$120	537	$3,997	33	$265	386	$3,499	17	$125	21	$135	2,199	$16,712
Gasoline boats	5	570	.....	.....	177	18,760	2	200	31	3,185	.....	.....	1	75	1,031	87,320
House boats	1	100	.....	.....	29	2,750	.....	.....	2	225	.....	.....	.....	.....	115	14,610
Total	43	925	19	120	743	25,507	35	465	419	6,909	17	125	22	210	3,345	118,642
Apparatus:																
Crowfoot bars.....pairs	26	282	.....	.....	564	7,484	7	70	109	1,266	.....	.....	13	130	2,212	24,395
Forks	1	1	4	5	455	617	23	30	374	449	9	16	7	9	1,103	1,441
Tongs	.....	.....	.....	.....	207	1,199	24	125	269	1,399	.....	.....	.....	.....	513	2,796
Rakes	.....	.....	.....	.....	3	5	.....	.....	.....	.....	.....	.....	2	4	85	119
Diggers or dip nets	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	102	658
Dredges	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	36	63
Miscellaneous apparatus	.....	2	.....	.....	.....	7	.....	.....	.....	.....	.....	.....	.....	.....	.....	9
Total	.....	285	.....	5	.....	9,312	.....	225	.....	3,114	.....	16	.....	143	.....	29,481
Shore and accessory property	.....	285	.....	60	.....	2,602	.....	95	.....	1,600	.....	40	.....	85	.....	18,732
Total investment	.....	1,495	.....	185	.....	37,421	.....	785	.....	11,623	.....	181	.....	438	.....	166,855

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PRODUCTS.																	
Shells:																	
With crowfoot bars	tons	230	4,226	.....	.....	1,459	23,801	31	503	290	5,171	.....	.....	60	675	15,258	245,477
With forks	do	1	12	14	231	753	12,530	31	501	932	16,355	22	550	12	160	3,292	55,757
With tongs	do	.....	.....	.....	.....	359	6,073	29	464	357	6,266	.....	.....	.....	.....	790	13,559
With rakes	do	.....	.....	.....	.....	7	120	.....	.....	.....	.....	.....	.....	7	85	161	2,856
With diggers or dip nets	do	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,733	28,200
With dredges	do	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	225	4,500
With miscellaneous apparatus	do	31	393	.....	.....	3	60	.....	.....	.....	.....	.....	.....	.....	.....	34	453
With hands	do	5	50	130	2,096	72	1,216	29	466	475	8,745	19	408	6	80	1,824	31,408
Total		267	4,681	144	2,327	2,653	43,800	120	1,934	2,054	36,537	41	958	85	1,000	23,317	382,210
Pearls		.....	1,900	.....	4,030	.....	24,191	.....	233	.....	8,543	.....	240	.....	1,025	.....	164,261
Total value of products		.....	6,581	.....	6,357	.....	67,991	.....	2,167	.....	45,080	.....	1,198	.....	2,025	.....	546,471

[a] Includes the La Crosse, Black, Wisconsin, Lemonweir, and Baraboo Rivers.
[b] Includes 4 women.
[c] Includes 6 men and 249 women.

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FISHERIES OF CHESAPEAKE BAY AND TRIBUTARIES.

The condition of the shad and alewife fisheries of Chesapeake Bay and its tributary streams has become more precarious, and the season of 1915 was the poorest of which there is any record. There is no evidence that the States vitally interested in the perpetuation of these valuable fisheries have taken any means to alleviate the flagrant overfishing to which the salt, brackish, and fresh waters have been subjected, and the only practical measure of protection which has been afforded the schools of spawning shad and alewives has come through the action of the War Department in requiring the stationary fishing apparatus to be set so that open channels in the bay and rivers may be left for navigation.

In April, 1915, as soon as the expected failure became evident, the Bureau instituted a very comprehensive canvass of the shad and alewife fisheries of the Chesapeake basin. In addition to furnishing detailed statistics, this canvass will show the location of fixed and floating apparatus and will enable the Bureau to make an authentic and forceful presentation of the situation.

STURGEON FISHERY IN FLORIDA.

After completing the field work of the survey of oyster beds in Apalachicola Bay, Fla., an assistant of the Bureau made inquiries in regard to the sturgeon fishery of the Apalachicola River. Principally because of inadequate transportation facilities the sturgeon fishery was not pursued actively prior to 1895. For a number of years the industry grew rapidly until the effects of depletion became manifest, and in quite recent years the decline of the fishery has been very marked. The period of fishery embraces about two and one-half months, from the middle of April to the end of June. The locality of the fishery is principally in the immediate vicinity of Apalachicola at the mouth of the river and extending upstream a distance of 30 miles. The sturgeon are known to ascend the river for a distance of 200 miles or more.

The sturgeon are usually captured by means of drift nets of 6-inch mesh. The body of the fish is cut into sections and packed in ice for shipment to northern markets. The preservation and sale of the caviar forms an important phase of the fishery. The catch varies from year to year; and, while no accurate statistics were taken, it was estimated that 20,000 to 60,000 pounds are marketed each season with a value of from $2,000 to $6,000. A single specimen has yielded a return of $90 from caviar alone. The average size of fish taken is becoming much smaller, while the value of the catch as a whole is declining.

The preservation of this important fish, now so nearly exterminated, should command the thoughtful attention of the State authorities.

ALASKA FISHERIES SERVICE.

A full report on the fishing industry of Alaska during the calendar year 1914 and on the activities of the Bureau in connection therewith has been published as an appendix of the annual report of the Commissioner for 1914. A special report on Alaska fishery investigations in 1914 was prepared by the Deputy Commissioner and issued in

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January, 1915. In view of the fact that the fishing season of 1915 has not yet ended, no report thereon is possible, and reference will be made to some of the more important developments of the last calendar year.

During the season of 1914 the Alaska fishing industry attained its highest value. The employment of 21,200 persons and the investment of $37,000,000 therein resulted in a yield of products valued at $21,243,000, an increase of $5,500,000 over the previous year. This great advance was due largely to the abundance of red salmon and the relatively high prices commanded by canned salmon.

In the patrol work along the Alaskan coast, the agents of the Bureau have found that the fishing interests in general are in sympathy with the protective laws and observe them fully. There have been, however, a number of more or less serious violations, usually by irresponsible employees. The fishery agents have successfully prosecuted a number of cases in the local courts, and have had the helpful cooperation of the United States attorneys and marshals.

The private salmon hatcheries in Alaska have been inspected, and during the season of 1914 all were found to be well conducted, although at some plants better facilities of feeding and rearing are desirable. During the fiscal year 1914 the five private hatcheries liberated over 64,000,000 red salmon fry, and were credited with rebates of taxes aggregating $25,741, the allowance being at the rate of 40 cents per thousand for red or king salmon fry planted.

Under date of April 27, 1915, the Bureau issued an announcement that a hearing would be had at Seattle on October 1 to determine the advisability of setting aside as preserves for spawning grounds and limiting or prohibiting commercial fishing therein certain waters in Alaska as follows: Barnes Lake, near Lake Bay, including all its tributary waters and its outlet; Hetta River and Lagoon, including all tributary waters; and Sockeye Creek, the outlet of Boca de Quadra hatchery waters, together with its tributaries; and an area or zone within 500 yards of the mouth of each of the above streams.

Under the authority conferred by the Presidential proclamation setting apart Afognak Island and adjacent islands as a fish-culture reserve, 73 licenses were issued to native inhabitants in 1914 to conduct fishing operations for salmon with seines and gill nets in the waters of the reservation. Their catch was 330,930 salmon, chiefly sockeyes and humpbacks, and were mostly disposed of at Kodiak.

A limited number of permits was granted during the year authorizing the carrying on of certain fisheries operations in the Aleutian Islands Reservation. It is the plan of the Department to make the fisheries within this reservation subservient to the welfare of the native inhabitants and to allow no fishing that would be disadvantageous to them or to the perpetuation of the fisheries. It having been found that fish for use as fox food on the Pribilof Islands could be secured to advantage from the reservation, arrangements were made early in 1915 whereby the natives would be given the opportunity of furnishing the required supply.

In the winter of 1914–15 the Bureau held protracted conferences with the representatives of fishing interests in Alaska regarding the

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amendment of the existing laws governing fishing in that territory. A comprehensive revision of the laws to meet new conditions was considered, and a bill was drafted and tentatively agreed on. It is hoped that this or a similar measure may be taken up at the next session of Congress.

FUR-SEAL SERVICE.

At the end of the last fiscal year reports of demoralization among Government employees and natives on the Pribilof Islands reached the Department, and immediately on their receipt the Deputy Commissioner, who was at the time on the Pacific coast, was dispatched in the *Albatross*. Following his investigation of the reports, which were for the most part sustained, the agent and caretaker and the storekeeper on St. Paul Island were removed, a general reorganization of the force was effected, and the natives were placed under much-needed restraint, especially in the matter of making and using intoxicating liquors. It is a pleasure to note a decided improvement in the moral and physical condition of the natives.

In March, 1915, the Department adopted regulations governing the delivery and use of intoxicating liquors on the seal islands, and embodied these regulations in a Departmental circular.

The special investigators who were sent to the islands in the summer of 1914 conducted their work in a very thorough manner, covering the seal and other animal life, the affairs of the natives, and the relations of the Government thereto. On their return in the fall they began the preparation of their report, which was completed and submitted on January 23, 1915. On February 17 the report was transmitted to Congress with a request for publication, and it was subsequently issued as a Senate document and also as a part of the Bulletin of the Bureau of Fisheries for 1914.

The census of the seal herd, taken by the special investigators with the assistance of the local Government representatives, showed the number of animals at the close of the breeding season to be approximately 294,687, as follows. These figures indicate an increase of 26,382 animals over 1913, although the number of pups born was only about a thousand more than in the previous year.

Classes.	Number.	Classes.	Number.
Breeding cows	93,250	Yearling bachelors	23,068
Breeding bulls	1,559	Yearling cows	23,067
Idle bulls	172	Pups	93,250
Young bulls (chiefly 5-year olds)	1,658		
Bachelors of 2, 3, and 4 years	41,241	Total	294,687
Cows 2 years old	17,422		

On the recommendation of the special investigators on the ground, the number of young bachelor seals that might be killed for the uses of the natives during the calendar year 1914 was fixed at 4,500, subject to increase if the circumstances demanded it. This quota, however, was apparently not needed, and only 2,735 seals were taken during the year. The annual shipment of pelts from the islands was made in October, consisting of 2,884 sealskins, 256 blue fox skins, and 25 white fox skins. These were taken to Seattle on the Coast Guard

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cutter *Manning* and thence forwarded to St. Louis. Owing to the depressed condition of the fur trade, the sale of the sealskins was deferred, under special authority given by Congress.

In 1915 arrangements were made for a complete census of the seal herd, to be taken by the Bureau's agents already on the seal islands, and figures submitted indicate an increase of about 60,000 animals over the estimate for 1914. The quota of bachelor seals that could be killed to meet the requirements of the natives was fixed at 5,500.

It is apparent from the report of the special investigators of 1914 and from the results of the census of 1915 that there exists a great surplus of male seals and that commercial killing on a limited scale could properly be resumed. A noteworthy economic contingency will arise when the taking of large numbers of seals begins. The comparatively limited needs of the natives will consume but a small part of the seal meat and other products, and steps have already been taken looking to the profitable utilization of what has heretofore been wasted.

The past year has witnessed an important change in the relations of the Government to the natives in the matter of compensation for services rendered. The old practice has been to pay cash for services, and a comparatively large part of the appropriation has thus been consumed. The natives used the cash thus obtained in purchasing supplies at the Government stores, and the sums thus received were turned into the United States Treasury. There was consequently a double drain on the appropriation which, in recent years at least, was none too large for the legitimate administration of the islands and the support of the natives. Under the new system, able-bodied natives are required to perform some kind of labor, and payment is made in supplies. This arrangement at first was resented by the natives, but in general is now working well. The agent on St. George Island reports that the natives "have both privately and as a body expressed their preference for the present method of issuing all necessary supplies as against receiving pay in cash for all labor and buying with their earnings their food and all other necessary articles." It is realized that on the resumption of commercial killing when, under the law, the natives will be entitled to cash compensation for services performed in various capacities, other arrangements will have to be made. It is believed that the expense which may be connected with the commercial operations should be deducted from the selling price of the sealskins and not from the appropriation for the maintenance of the fur-seal service.

Owing to a change in the personnel on the islands, the savings of the seal-island natives, heretofore kept in a San Francisco bank in the name of a trustee, have been transferred to Washington and deposited in a local bank, and the United States Commissioner of Fisheries has been designated as trustee. The amounts thus transferred and held to the credit of the natives are $5,143.12.

An entirely new method of procedure in obtaining supplies for the Pribilof Islands was adopted for the 1915 season. In the past the general supplies have been bought either without competition or on more or less formal proposals. This year formal schedules were prepared and printed copies were distributed to prospective bidders at Seattle, San Francisco, St. Louis, Chicago, New York, Boston, and

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other points. While the form of proposal used permitted bidders to designate the point where they proposed to deliver the material bid upon, the majority of proposals designated Seattle as the point of delivery. Of the proposals accepted all but two were for delivery in Seattle. The business of making contracts in connection with the accepted proposals and the ordering and assembling of supplies were in progress at the end of the fiscal year.

A shortage of certain supplies on the Pribilof Islands made it necessary to arrange for a small consignment during the winter season of 1914–15. Space was accordingly secured on the schooner *Bender Bros.*, which left Seattle on February 27, 1915, for Alaskan points. The vessel arrived at St. Paul Island April 1 and at St. George Island the next day. The sending of a ship annually to the Pribilofs during the winter season should be done if practicable. A procedure of this kind would (*a*) permit supplying the islands with fresh provisions, (*b*) obviate any deficiency which might arise in the stock of staple supplies, (*c*) effect the transfer of mail, and (*d*) afford a welcome relief to the Government employees from the enforced monotony of the long winter season.

In accordance with the law, arrangements were made by the Coast Guard for the patrol of the North Pacific Ocean and Bering Sea during the season of 1915 by vessels of that service. The *Unalga* was designated to patrol the waters between Kodiak Island and the western end of the Aleutian Chain from the beginning of the season until July 15. The *Manning* was designated to relieve the *Unalga* July 15 and patrol the Bering Sea until the end of September. The vessels were to visit the Pribilofs from time to time for the purpose of conveying mail from Unalaska to those islands. In June, 1915, the agent on St. Paul Island reported to the *Unalga* that there were evidences of poachers in the vicinity of that island (reports were also made by him directly to the Bureau) and a careful search was undertaken by that vessel, but with only negative results.

MINOR FUR-BEARING ANIMALS.

With the limited force and funds available, the Bureau has administered as thoroughly as practicable the laws and regulations pertaining to the minor fur-bearing animals of Alaska, whose aggregate value and importance exceed the fur seal at present. The number of wardens for this service was increased from 5 to 7 in the fiscal year 1915, and in addition thereto one special fur warden previously employed was continued at a nominal salary.

In May, 1915, the Department approved a revision of the regulations for the protection of fur-bearing animals in Alaska as recommended by the Bureau; and under date of May 24, 1915, these regulations were issued (Department Circular no. 246, third edition). The principal features of the new regulations are as follows:

No change of seasons for the killing of fur-bearing animals was made; prohibition was placed upon the use of "klips" and the steel bear trap or any other trap with jaws having a spread exceeding 8 inches; no attempt was made to place restrictions upon the taking of fur-bearing animals alive, so long as no killing was involved; the shipping of live fur-bearing animals from Alaska was not inter-

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dicted; and the requirement that persons engaged in fur farming should secure a license from the Department was discontinued.

At the end of the fiscal year four of the Alaska Islands which the Department may lease for fur-farming purposes were so leased. The plan of supplying blue foxes for breeding purposes from the Pribilof Islands has not been continued since the summer of 1914. In addition to the difficulty experienced in making deliveries of live animals from this remote region, it was felt that the conditions of the herds did not warrant depleting them of the best potential breeding elements, which animals the prospective breeders would naturally require. A portion of the animals sold in 1914 were taken to a ranch in Michigan; they have not yet bred in their new environment, and the results of the venture are awaited with interest.

The total value of the minor furs sent out of Alaska in the year ending November 15, 1914, was approximately $650,000. The two most conspicuous furs as regards aggregate value are red fox and mink, although white fox, lynx, muskrat, and marten are also important. It is a pleasure to be able to report a rapid increase in beavers in southeastern Alaska and in various parts of the interior; and a further marked increase may confidently be expected as a result of the prohibition of the killing of beavers until November 1, 1918.

In view of the incongruity of including strictly terrestrial animals in a bureau devoted to aquatic animals and the fisheries, it is believed that Congress should make early provision for a change in the administration of the laws pertaining to the minor fur-bearing animals of Alaska, in accordance with recommendations that have been made in former reports. Aside from the question of administration, there are anomalies and inconsistencies in the existing laws that call for immediate attention; and, furthermore, the general act protecting the fur bearers is fundamentally defective.

This matter has been taken up by the Departments of Commerce and Agriculture through a committee of four persons representing the Bureau of Fisheries and the Bureau of Biological Survey, and an agreement has been reached under which an appeal will be made to Congress for a proper allocation of duties in the two departments. The recommendations of the committee, submitted April 10, 1915, and approved by the respective Secretaries, provide (1) that Congress be requested to order the transfer to the Department of Agriculture of jurisdiction over the terrestrial fur-bearing animals of Alaska now exercised by the Department of Commerce; and (2) that at the same time the Department of Commerce should be given exclusive jurisdiction over all aquatic or amphibious animals whose pursuit constitutes a fishery, such as walrus, whales, porpoises, and sea lions, in addition to fur seals and sea otters.

MISCELLANEOUS MATTERS.

MOVEMENTS OF VESSELS.

In June, 1914, the *Albatross* was dispatched to the Pribilof Islands with the Deputy Commissioner, who subsequently used the vessel for an inspection of the fisheries in parts of central and western Alaska. On August 15 the Deputy Commissioner disembarked at Juneau, and

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the vessel immediately returned to Seattle and, after some refitting, resumed the investigation of the halibut banks off Washington and Oregon which had been in progress during the preceding year. This work was completed for the season on September 9, when the ship was sent to Sausalito and there laid up for the balance of the year, as lack of funds prevented any further activities. From the inception of the halibut investigation in April, 1914, till the arrival at Sausalito, September 16, the vessel steamed 11,005 miles.

The auxiliary schooner *Grampus* continued during the summer of 1914 the oceanographic investigations in the Gulf of Maine and as far south as Nantucket. During the fall and winter the schooner was laid up, and the crew were employed to assist in the fish-cultural work of the Gloucester station. On May 4, 1915, the offshore work of the preceding year was resumed and was in progress on June 30.

The *Fish Hawk* was employed in surveying offshore fishing grounds in connection with the Beaufort laboratory in the summer of 1914, and in December was sent to the west coast of Florida for use in the oyster-grounds survey authorized by Congress. This work was duly completed, and on May 13 the vessel arrived at Norfolk, Va., where, after overhauling and refitting, preparations for further service on the North Carolina coast were made. During the year the vessel steamed about 5,000 miles.

The *Osprey* was engaged in the usual patrol work in southwestern Alaska, and was utilized by the Deputy Commissioner during his inspection trip to that region in the summer of 1914.

The *Phalarope* was attached to the Woods Hole station during most of the year, and was utilized in connection with both the fish-cultural and biological work. In the spring of 1915 the vessel was detailed, as heretofore, to assist in the shad hatching on the Potomac River.

The *Curlew* was engaged in the rescuing of fishes from the overflow waters of the Mississippi River and in the propagation of pearl mussels.

VESSEL FOR ALASKA SERVICE.

The well-known arctic-exploration steamer *Roosevelt* has been purchased in New York for the Alaska service, and has undergone a general overhauling, including the substitution of oil-burning for coal-burning machinery. The vessel started for the Pacific coast on July 19, after a trial trip; but on the run from New York to Norfolk, where a cargo of coal for the Pribilof Islands was to be taken aboard, certain unforeseen defects in machinery developed, and it was necessary to send the vessel to the Norfolk Navy Yard for a thorough inspection and special repairs, which have delayed the departure for the Pacific coast.

NEW VESSEL FOR THE MAINE COAST.

A special appropriation of $45,000, for a vessel for the Boothbay Harbor station, was made immediately available in the sundry civil appropriation act approved March 4, 1915. It was thought at first that it would be possible to purchase a suitable craft in first-class

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condition at a less price than one could be built for, and with the added advantage that she would be available for immediate use. Exhaustive inquiries at all practicable shipping ports were accordingly made, and many offerings were considered, but without finding a satisfactory vessel. The experience of this and other bureaus has shown that in general the policy of purchasing second-hand vessels is unwise. Such vessels are never primarily suited for the Bureau's purposes, and to rebuild them is an expensive matter, with final unsatisfactory results. Ordinarily, too, if they are in first-class condition, they are not cheap. It was, therefore, finally decided to build a new vessel designed not only for the local activities of the Boothbay station but also for offshore research, surveys, and exploitation of the fisheries. Plans are now being prepared in the Bureau of Lighthouses, and as soon as completed bids for the construction will be called for.

NEW ESTABLISHMENTS AND CONSTRUCTION.

The sites for the new hatchery in Utah and the new biological laboratory in Florida had not yet been acquired at the end of the fiscal year owing to delays on the part of the owners in furnishing titles satisfactory to the Department of Justice. No title has yet been obtained for the additional land which is to be acquired for the Cold Spring station in Georgia.

The work of reconstructing the wharves and building a retaining bulkhead at the Woods Hole station has been placed under the supervision of Army engineers. The new wharves, while less extensive than the older ones, will be of ample capacity for the Bureau's needs and will be much less expensive to maintain. The demolition of the coal shed has been made necessary by its location on the old wharf.

At Saratoga, Wyo., a hatchery, a superintendent's dwelling, and a cottage for the fish culturist have been nearly completed; work is also well advanced on the pond and drainage systems; and a railroad siding is being built.

The biological station at Beaufort, N. C., has been extensively repaired and put in first-class order with a small appropriation granted by the last Congress. The wooden underpinning of the laboratory has been replaced with brick; a veranda has been added on the south front; new salt-water plumbing has been installed; the buildings have been repainted; general repairs have been made; the protecting sea wall has been extended; and the grounds have been graded, planted, and put in thorough order. A terrapin pond and large fish pool have been added to the plant.

At Edenton, N. C., a mess house, 25 feet square, suitably arranged for the necessary quarters, is under construction with the special appropriation made at the last session of Congress.

In an effort to relieve the crowded condition of the offices in the Bureau's building in Washington, part of the space on the ground floor, heretofore occupied by Central Station for fish-hatching and other purposes, has been converted into six new office rooms separated by a double row of aquarium tanks leading into the grotto. A new ceiling and new floor have been laid, the seal pool has been reconstructed and enlarged, and a small space has been reserved for

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fish-hatching operations and an exhibit of some of the activities of the Bureau.

FISHERY MATTERS IN CONGRESS.

By a joint resolution approved February 24, 1915, the Secretary of Commerce was authorized to postpone the sale of all skins in possession of the Government taken from seals killed on the Pribilof Islands for food purposes until such time as, in his discretion, he shall deem advisable.

A bill was passed on February 18, 1915, authorizing the Secretary of Commerce, through the Coast and Geodetic Survey and the Bureau of Fisheries, to make a survey of oyster beds in the State of Texas. Owing to a defect which imposed an unintended financial burden on the Bureau, the bill was withdrawn by the Senate after it had been sent to the President for approval, and was not reenacted.

Defects in the law of June 20, 1906, for the protection of sponges were corrected in a bill which passed both Houses and was approved August 15, 1914. This law, which was advocated by the Bureau, regulates the taking of sponges in extraterritorial waters of the coast of Florida. The principal provision of the act is the limiting of the size of sponges that may be taken, or landed, cured, offered for sale, or had in possession to 5 inches in maximum diameter.

A bill to prohibit interstate and foreign commerce in lobster meat and in undersized or egg-bearing lobsters was introduced in the House on July 2, 1914, and referred to the Committee on Interstate and Foreign Commerce.

A bill approved by this Bureau authorizing the Commissioner of Fisheries to conduct investigations and experiments for ameliorating the damage wrought to the fisheries by predaceous fishes and other aquatic animals was introduced in the House and recommended by the Committee on the Merchant Marine and Fisheries. This bill was so amended on the floor of the House before it passed that body as to leave the Bureau with fewer powers than it already possessed, and it failed of passage in the Senate.

The Sixty-third Congress expired without making effective the treaty of April 13, 1908, providing for joint international regulations for the fisheries in the contiguous waters of the United States and Canada. The matter had been pending in Congress since 1910. The present international commissioner on behalf of the United States labored assiduously to meet the objections that had been urged against various features of the regulations and cooperated in the drafting of a bill which fully safeguarded all the interests of the United States fishermen. This failure to respect our treaty obligations leaves the international fisheries in a chaotic condition and leads to the fear that further depletion of international waters will result because of inharmonious laws and incompatible jurisdictions.

In March, 1915, a bill to amend the laws for the protection and regulation of the fisheries of Alaska was introduced in the House, but owing to the imminent adjournment of Congress no action was taken thereon.

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PUBLICATIONS AND LIBRARIES.

During the fiscal year the following publications were issued and distributed through the Superintendent of Documents on special mailing lists:

REPORT OF THE COMMISSIONER AND APPENDICES THERETO.

Report of the Commissioner of Fisheries to the Secretary of Commerce for the fiscal year ended June 30, 1914. 81 p.

The distribution of fish and fish eggs during the fiscal year 1913. Appendix I to Report of Commissioner for 1913. 122 p.

Alaska fisheries and fur industries in 1913. Appendix II to Report of Commissioner for 1913. 172 p.

Experimental study of the growth and migration of fresh-water mussels. By Frederick B. Isely. Appendix III to Report of Commissioner for 1913. 24 p., 3 pl.

Experiments in propagation of fresh-water mussels of the Quadrula group. By Arthur Day Howard. Appendix IV to Report of Commissioner for 1913. 52 p., 6 pl.

The mussel fauna of central and northern Minnesota. By Charles B. Wilson and Ernest Danglade. Appendix V to Report of Commissioner for 1913. 26 p., 1 map.

The mussel resources of the Illinois River, by Ernest Danglade. The mussel fishery of the Fox River, by John A. Eldridge. Appendixes VI and VII to Report of Commissioner for 1913. 48 p., 5 pl., 2 text fig., chart, 8 p.

Water-power development in relation to fishes and mussels of the Mississippi. By Robert E. Coker. Appendix VIII to Report of Commissioner for 1913. 28 p., 6 pl.

The distribution of fish and fish eggs during the fiscal year 1914. Appendix I to Report of Commissioner for 1914. 114 p.

Condition and extent of the natural oyster beds and barren bottoms of Lavaca Bay, Tex. By H. F. Moore and Ernest Danglade. Appendix II to Report of Commissioner for 1914. 45 p., 5 pl., 1 chart.

Menhaden industry of the Atlantic coast. By Rob Leon Greer. Appendix III to Report of Commissioner for 1914. 27 p., 7 pl.

Mussel resources in tributaries of the upper Missouri River. By Robert E. Coker and John B. Southall. Appendix IV to Report of Commissioner for 1914. 17 p., 1 pl., 1 map.

Identification of the glochidia of fresh-water mussels. By Thaddeus Surber. Appendix V to Report of Commissioner for 1914. 9 p., 1 pl.

Otter-trawl fishery. By A. B. Alexander, H. F. Moore, and W. C. Kendall. Appendix VI to Report of Commissioner for 1914. 97 p., 9 text fig., 1 chart, 1 diag.

Survey of the fishing grounds on the coasts of Washington and Oregon in 1914. By Waldo L. Schmitt, E. C. Johnston, E. P. Rankin, and Edward Driscoll. Appendix VII to Report of Commissioner for 1914. 30 p., 1 pl., 2 charts, 1 paster.

The Fishes of the Yellowstone National Park. By W. C. Kendall. Appendix VIII to Report of Commissioner for 1914. 28 p., 17 text figs.

BULLETIN OF THE BUREAU OF FISHERIES.

A limnological study of the Finger Lakes of New York. By Edward A. Birge and Chauncey Juday. Bulletin, vol. XXXII, 1912, p. 525–610, 23 text fig., pl. CXI–CXVI (maps).

The embryology and larval development of Bairdiella chrysura and Anchovia mitchilli. By Albert Kuntz. Bulletin, vol. XXXIII, 1913, p. 1–20, 46 text fig.

The skeletal musculature of the king salmon. By Charles Wilson Greene and Carl Hartley Greene. Bulletin, vol. XXXIII, 1913, p. 21–60, pl. I–II, 14 text fig.

The directive influence of the sense of smell in the dogfish. By G. H. Parker. Bulletin, vol. XXXIII, 1913. p. 61–68.

The storage of fat in the muscular tissue of the king salmon and its resorption during the fast of the spawning migration. By Charles W. Greene. Bulletin, vol. XXXIII, 1913, p. 69–138, pl. III–XI.

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Correlations of weight, length, and other body measurements in the weakfish, Cynoscion regalis. By William J. Crozier and Selig Hecht. Bulletin, vol. XXXIII, 1913, p. 139–148, 4 text fig.

The fat-absorbing function of the alimentary tract of the king salmon. By Charles W. Greene. Bulletin, vol. XXXIII, 1913, p. 149–176, pl. XII–XV.

Notes on the habits, morphology of the reproductive organs, and embryology of the viviparous fish Gambusia affinis. By Albert Kuntz. Bulletin, vol. XXXIII, 1913, p. 177–190, pl. XVI–XIX.

Sporozoön parisites of certain fishes in the vicinity of Woods Hole, Mass. By C. W. Hahn. Bulletin, vol. XXXIII, 1913, p. 191–214, pl. XX–XXI.

Fur seals and other life in the Pribilof Islands, Alaska, in 1914. By Wilfred H. Osgood, Edward A. Preble, and George H. Parker. Bulletin, vol. XXXIV, 1914, p. 1–172, pl. I–XVIII, 24 maps.

SPECIAL PUBLICATION.

Report of Alaska investigations in 1914. By E. Lester Jones, 155 p., illus.

ECONOMIC CIRCULARS.

Commercial possibilities of the goosefish, a neglected food; with 10 recipes. 5 p. Dec. 15, 1914.

Mussel resources of the Tensas River of Louisiana. 7 p. April 9, 1915.

The common and scientific names of fresh-water mussels. 4 p. April 8, 1915.

Concerning the mortality of the soft clams at Essex, Mass. 4 p., illus. April 18, 1915.

STATISTICAL BULLETINS.

Monthly statements showing by species and fishing grounds the quantity and values of certain fishery products landed at Boston and Gloucester, Mass., by American fishing vessels. 1-sheet bulletin.

Statement, by months, of the quantities and values of certain fishery products landed at Boston and Gloucester, Mass., by American fishing vessels during the year 1914. 1-sheet bulletin.

Statement, by fishing grounds, of the quantities and values of certain fishery products landed at Boston and Gloucester, Mass., by American fishing vessels during the calendar year 1914. 1-sheet bulletin.

Fresh-water pearl button industry of the United States in 1912. 1-sheet bulletin.

Fresh-water mussel fishery of streams tributary to the Great Lakes and the Ohio and Mississippi Rivers north of the Ohio and east of the Mississippi River in 1913. 1-sheet bulletin.

Lobster fishery of the Atlantic Coast States in 1913. 1-sheet bulletin.

Beginning with June, 1915, a monthly publication, entitled Fisheries Service Bulletin, was started and seems destined to serve a useful purpose. The objects, as stated in the first issue, are to bring into closer touch the headquarters and the field service and to establish a means of official communication between the administrative offices and all employees. The publication is supplied to each employee of the Bureau, to State fishery authorities, to the press, and to private individuals interested or identified with the fisheries in their broad aspects.

The Bureau has at its headquarters in Washington a library reputed to be the most complete in the world in publications on the fisheries and related subjects. Auxiliary libraries are maintained at the laboratories at Woods Hole, Mass., Beaufort, N. C., and Fairport, Iowa, and there is a small but well-selected collection of books on the Fisheries steamer *Albatross* on the Pacific coast. The main library contains over 29,000 volumes, that at Woods Hole about 2,000, and those at Beaufort and Fairport about 1,000 each. All are being rapidly augmented by purchase and exchange. These publications are intended primarily for workers in the Bureau's service, but the

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public is encouraged to use them. Many works available nowhere else in the United States may be consulted in these libraries, which are well catalogued, and the librarian in Washington and the directors of the several laboratories will render all possible assistance to inquirers.

APPROPRIATIONS.

The appropriations for the conduct of the Bureau for the fiscal year 1915 aggregated $1,118,471.66, as follows:

Salaries	$387,971.66
Miscellaneous expenses:	
Administration	10,000.00
Propagation of food fishes	350,000.00
Inquiry respecting food fishes	45,000.00
Statistical inquiry	7,500.00
Maintenance of vessels	60,000.00
Protecting the sponge fisheries	3,500.00
Protecting seal and salmon fisheries of Alaska	110,000.00
Construction or purchase of vessels, Alaska service	50,000.00
Completion of, extension of, and improvements at fish-cultural and biological stations:	
Utah	25,000.00
Cold Spring, Ga	6,000.00
Woods Hole, Mass	40,000.00
Clackamas, Oreg	15,000.00
Beaufort, N. C	5,000.00
Edenton, N. C	3,500.00

SOME NEEDS OF THE SERVICE.

In the estimates of appropriations for 1917 which have been submitted for the approval of the Secretary, provision is made for a readjustment of the salaries of a number of underpaid positions, including the superintendent of the car and messenger service, directors of biological stations, and superintendents of hatcheries. The increases which are recommended in these cases are demanded by the nature and responsibility of the services required and by the fact that similar positions in other Government bureaus and in private establishments command much higher salaries. The compensation now fixed by law for the superintendents of most of the stations is less than was paid 20 years ago, notwithstanding a very marked increase in the work required of and performed by them. The Bureau is often unable to secure or retain the services of technically qualified assistants of great value to the work because the salaries carried by the positions are less attractive than those offered by other Government departments, by the various States, by foreign governments, and by private establishments. The constant loss of trained men is a serious impairment of efficiency, and demands a proper adjustment of the salaries of various statutory positions other than those already referred to.

Recommendation is made for a reorganization of the administrative personnel on the Pribilof Islands, Alaska, involving the creation of new positions and an increase in the compensation of the chief officer on each island. This recommendation, which is embodied in the estimates of appropriations for 1917, is based on the experience of the Bureau. The very large Government property interests at

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stake, the international rights in the seal herd, and the welfare of the native community, justify more liberal expenditures than have ever been made for the fur-seal service.

The Bureau of Fisheries occupies the anomalous position of having its two most important vessels officered and manned by another department of the Government. The circumstances are as follows: Since the construction of the steamer *Fish Hawk* in 1879 and the steamer *Albatross* in 1882, these vessels have had naval crews under authority conveyed by law (21 Stats., 151). The naval personnel of the *Fish Hawk* at this time consists of 44 officers and men, the commanding officer being a chief boatswain. The naval personnel of the *Albatross* numbers 81 officers and men, the commanding officer being a lieutenant-commander. The annual salaries of the naval personnel of these two vessels, including the allowance for subsistence, are approximately $102,000.

A careful consideration of the requirements of the Bureau indicates that a material reduction in the personnel of these vessels may be effected if civilian officers and crews are substituted for naval officers and crews. In the case of the *Albatross* it is found that 35 men as against 81 men will be ample, and in the case of the *Fish Hawk* that 26 men as against 44 men will suffice. The annual cost of the proposed civilian officers and crews would be $56,292.50, exclusive of any allowance for subsistence, for which there is no authority of law in this service.

The Navy Department from the outset has been most liberal in providing efficient officers and crews for these two vessels, and this Bureau is under the most profound obligations for this invaluable cooperation. However, in view of the foregoing statements, and because of the intimation that has from time to time come from the Navy Department that its officers and men are needed for service on naval vessels, it is believed that Congress should be asked to authorize civilian crews. To this end an item has been inserted in the estimates of appropriations for the next fiscal year.

The placing of the *Albatross* and *Fish Hawk* under civilian management will be an opportune time for the reorganization of the personnel of the entire vessel service, so as to put the Bureau of Fisheries on a par with the Bureau of Lighthouses and the Coast and Geodetic Survey. This is demanded in the interests of efficiency and economy. It appears that a reorganization that will afford sufficient men for the vessels, and allow them compensation which will be an inducement for efficient men to remain in the service, can be accomplished at an annual saving of $25,000 to $30,000. With this in view, there has been included in the estimates of appropriations for 1917 an item for a lump-sum appropriation to cover the compensation of all vessel employees instead of specific provision for the personnel of each vessel, as at present. The Bureau of Fisheries appears to be the only bureau in the Department of Commerce whose vessel employees are not given an allowance for subsistence. Congress should therefore be requested to authorize the vessel personnel of the Bureau of Fisheries to enjoy the same status accorded in other bureaus.

Comparatively small increases are required in the appropriations for propagation of food fishes, inquiry respecting food fishes and fishing grounds, and statistical inquiry, in order that existing

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agencies may be fully utilized and opportunity be afforded for extending the scope and increasing the usefulness of the various activities of the Bureau. A very substantial increase in the appropriation for the maintenance of vessels is imperative, so that costly vessel property may not be forced to remain idle when much important work should be done. The case of the *Albatross* in the year 1914–15 may be cited, but the conditions then were not peculiar, only exaggerated. This vessel, with a crew of 85 officers and men, was laid up during about three-fourths of the year, when less than $10,000 would have enabled the Department to keep her in service and make needed investigations during the time when the pay of the naval crew and other permanent charges against the vessel exceeded $30,000.

The welfare of the lobster industry demands at the hands of the Federal Government the immediate rendering of the most effective form of assistance that can be extended to the States. Experience and investigation have amply demonstrated that the mere hatching and planting of the lobster fry is inadequate to maintain the supply in the face of an increasing demand, inharmonious laws not consistently enforced or generally respected by the fishermen, and the strong inducement to violation of law occasioned by the high prices. There are a genuine need and a legitimate public demand for lobster rearing as a supplement to or substitute for the present operations of the lobster hatcheries, and an item for a rearing plant has been included in the Bureau's estimates of appropriations for the next fiscal year.

Representations made in former years regarding the need for a new building with ample laboratory and aquarium facilities are strongly renewed.

Respectfully,

H. M. SMITH,
Commissioner.

To Hon. WILLIAM C. REDFIELD,
Secretary of Commerce.

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REPORT

OF THE

COMMISSIONER OF LIGHTHOUSES

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REPORT

OF THE

COMMISSIONER OF LIGHTHOUSES.

DEPARTMENT OF COMMERCE,
BUREAU OF LIGHTHOUSES,
Washington, September 15, 1915.

SIR: The following report is submitted of the operations of the Lighthouse Service for the fiscal year ended June 30, 1915.

PROGRESS OF THE LIGHTHOUSE SERVICE IN PAST FIVE YEARS.

As a period of five years has passed since the reorganization of the Lighthouse Service under the act of Congress which took effect July 1, 1910, a brief review of the progress of lighthouse work in the United States during that period is given below. The main features of the reorganization law were to provide a more direct administration by placing the Lighthouse Service under a simple bureau form of organization with civilian officers, instead of a board of detailed officers, and by consolidating the work in each lighthouse district under a single officer, the inspectors in all but the three river districts being civilians selected under civil-service requirements.

The total number of aids to navigation on June 30, 1915, was 14,544, as compared with 11,713 on June 30, 1910, representing a total net increase during the five-year period of 2,831, or 24 per cent, an average of 566 per year. For the preceding five-year period, namely, from June 30, 1905, to June 30, 1910, the total increase was 1,793, or an average of 359 per year.

Careful consideration has been given, in the interests of economy and efficiency, to the discontinuance of lights and other aids no longer required by navigation, so that the above figures represent a net increase, after allowing for 2,580 aids to navigation which have been discontinued during the past five years.

In respect to the appropriations for maintenance of the service, attention is invited to the diagram on page 562 comparing the number of aids maintained with the total maintenance appropriations for a period of 15 years from 1901 to 1915.

Careful attention has been given to the improvement of apparatus and equipment, in accordance with the best modern practice of coast lighting. Gas buoys, which are more appreciated by mariners than any other recent addition to coast lighting, have been increased from 225 in 1910 to 479 in 1915, a total increase of 254, or 113 per cent.

The use of oil-vapor lamps increases the illuminating power from a given quantity of kerosene oil by about eight times, and these lights have been greatly appreciated because of their superior bril-

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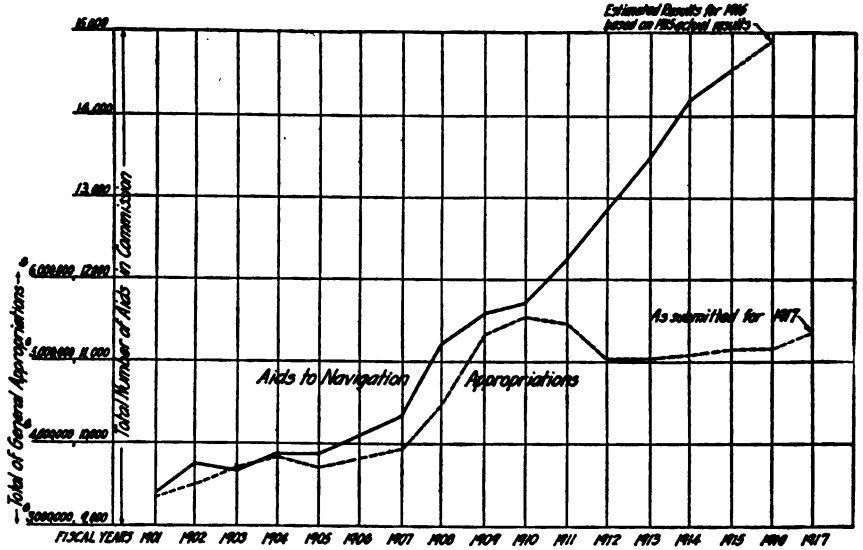
liancy. The number of oil-vapor installations at light stations has been increased from 80 in 1910 to 286 in 1915, a total increase of 206 stations, or 257 per cent. Most of the primary coast lights are now provided with oil-vapor lamps.

On the Atlantic coast, of the 70 primary lights, 16 used oil vapor in 1910 and 64 in 1915; on the Pacific coast 2 used oil vapor in 1910 and 32 out of the 34 primary lights used oil vapor in 1915.

Many of the older lights were fixed and did not have a characteristic which would distinguish them from other lights. Steady progress has been made in changing such lights, where doubt might occur, to flashing or occulting, and 169 lights have been so improved in the five-year period just completed. Especially marked progress in this respect has been made on the Pacific coast, where of the primary lights in 1910, 11 were fixed lights, whereas in 1915 only 2 out of 34


Estimated Results for 1916
based on 7/8 actual results
As submitted for 1917
Aids to Navigation
Appropriations
Total Number of Aids in Commission
Total of General Appropriations
FISCAL YEARS 1901 1902 1903 1904 1905 1906 1907 1908 1909 1910 1911 1912 1913 1914 1915 1916 1917

U.S. Lighthouse Service
Number of Aids to Navigation and Annual Appropriations
1901–1917

are fixed lights; of the total primary lights on the Atlantic and Pacific coasts in 1910, 65 were flashing or occulting and 37 fixed, and in 1915, 80 were flashing or occulting and 24 fixed.

There has been a strong demand for improved lighting of the Alaskan waters, and the number of lights on the coast of Alaska has been increased from 37 in 1910 to 112 in 1915, an increase of 75, or 203 per cent.

The total number of fog signals, including sounding buoys, has increased from 844 in 1910 to 1,044 in 1915, an increase of 200, or 24 per cent. Classified as to types, the increases have been: Fog signals on shore, 498 to 527; whistling buoys, 104 to 149; bell buoys, 200 to 318; submarine bells, 42 to 50.

Although the number of aids to navigation has steadily increased, as shown above, involving an increase in all the operations of the Service, it has been possible to maintain this increased number of aids with a less number of lighthouse tenders, owing to the simplifi-

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cation of work and concentration of authority under the reorganization. Thus, in 1910 there were 51 lighthouse tenders, in 1913 44 tenders, and in 1915 47 tenders. With the considerable increase of 24 per cent which has been made in the total number of aids to navigation, a gradual increase in tenders has now become necessary. Both for this reason and because of the necessity of replacing tenders as they are worn out in service, 3 tenders are now under construction and estimates are submitted for others.

The number of light vessels and light-vessel stations has diminished by a slight amount, 2 vessels and stations, during this five-year interval, the increase which might normally have been expected having been offset by the large increase in gas buoys, many of them equipped with whistles, bells, and submarine bells, thus supplying important aids to a much larger number of localities and at much less expense than would have been possible with light vessels. There has, however, been a steady construction of new light vessels to replace those worn out in service.

During the five years since 1910 the organization and business methods of the Lighthouse Service have been thoroughly examined and revised wherever it appeared advantageous to do so. Nineteen persons have been appointed as civilian lighthouse inspectors, all selected solely on their technical qualifications; 15 of these were promoted in the Lighthouse Service, where each had served from 5 to 40 years, and the other 4 had had experience of from 8 to 13 years each on other Government vessels engaged in related technical work. The two offices in each district were combined into one, and the office force and the use of the lighthouse tenders rearranged on a business basis. A general inspector and an examiner were appointed, who make periodic inspections of the technical and business methods in each district. A cost-keeping system for the whole Service has been inaugurated. The Regulations and the Instructions have been thoroughly revised. Annual conferences of lighthouse inspectors have been held, and a monthly lighthouse bulletin is issued to the Service. Aids and cadets have been appointed for training in lighthouse engineering and nautical work. The lighthouse publications have been simplified and systematized. Important economies and improvements have been introduced in the use and handling of supplies and accounting for property. The form of appropriations has been simplified. Full cooperation has been arranged between the Lighthouse Service and other branches of the Department of Commerce, other correlated bureaus of the Government, and maritime interests. Radio installations have been made on several tenders, and many improvements of apparatus have been perfected or introduced.

In securing increased efficiency and economy the welfare of the personnel has also been constantly considered. Legislation has been secured providing for compensation for injuries received in hazardous work of the Lighthouse Service, the subsistence arrangements on vessels and the accommodations for crews have been improved, leave of absence has been granted to per diem employees, a medical handbook has been published, and the cooperation of the Public Health Service arranged for. A retirement system has been repeatedly advocated for deserving employees who have earned this consideration.

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The present general organization of the Service under the act of June 17, 1910, is briefly as follows:

There is an office in Washington, which is the executive center of the Service, under the Commissioner of Lighthouses and the Deputy Commissioner. There are in this office an engineering construction division, under the chief constructing engineer; a naval construction division, under the superintendent of naval construction; a hydrographic division, under an assistant engineer, and the general office force, under the chief clerk. The Service outside of Washington is divided into 19 lighthouse districts, each under the charge of a lighthouse inspector. In each district there is a central office and one or more lighthouse depots. Each district is provided with lighthouse tenders for distributing supplies to the various stations and light vessels, for transportation of materials for construction or repair, and for care of buoys. In addition, there is in the third lighthouse district, on Staten Island, New York Harbor, a general lighthouse depot, where supplies are purchased in quantities, special apparatus is manufactured or repaired, and various experimental work is conducted.

PERSONNEL.

The following table gives the number of employees (all authorized positions, including some vacancies) of the Lighthouse Service at the end of the fiscal year and a comparison of the totals with those for the previous fiscal year.

EMPLOYEES IN THE LIGHTHOUSE SERVICE ON JUNE 30, 1915.

District.	Inspectors, engineering force, draftsmen, aids, appointed foremen, and mechanicians.	Clerks, messengers, janitors, and office laborers.	Depot keepers and assistants, including laborers.	Light keepers and assistants.	Laborers in charge of lights (appropriation "Salaries, keepers of lighthouses").	Laborers in charge of post lights and buoys (appropriation "General expenses").	Custodians of reservations.	Officers and crews on tenders and light vessels.	Field force for construction and repair (registered).	Field force for construction and repair (unregistered).	Total.
Bureau	19	26	.....	.....	.....	.....	.....	.....	.....	.....	45
First	3	6	1	114	2	.....	.....	89	9	4	228
Second	4	7	2	81	10	.....	.....	204	3	5	316
Third	22	28	10	178	33	58	2	264	170	44	809
Fourth	5	5	3	54	10	12	6	29	5	20	149
Fifth	10	9	17	173	95	23	2	237	11	12	589
Sixth	5	7	2	56	9	26	.....	117	3	7	232
Seventh	2	3	1	43	1	.....	.....	25	5	28	108
Eighth	6	7	7	109	23	34	.....	94	7	21	308
Ninth	2	5	1	34	4	.....	.....	22	15	6	89
Tenth	7	5	2	66	3	.....	.....	33	5	28	149
Eleventh	8	6	6	157	11	2	1	102	23	29	345
Twelfth	7	6	6	161	2	12	1	90	5	19	309
Thirteenth	1	2	.....	.....	.....	324	.....	18	.....	.....	345
Fourteenth	1	2	.....	.....	.....	540	.....	.....	.....	.....	543
Fifteenth	1	2	.....	.....	.....	404	.....	18	.....	.....	425
Sixteenth	5	4	1	29	.....	11	.....	44	2	54	150
Seventeenth	5	6	4	78	15	106	.....	104	5	6	329
Eighteenth	6	6	7	111	6	4	.....	90	10	19	259
Nineteenth	4	3	1	27	2	.....	.....	25	.....	3	65
Total, 1915	123	145	71	1,471	226	1,556	12	1,605	278	305	5,792
Total, 1914	93	143	56	1,485	211	1,563	13	1,563	227	208	5,562
Increase	30	2	15	.....	15	.....	.....	42	51	97	[a] 230
Decrease	.....	.....	.....	14	.....	7	1	.....	.....	.....	.....

[a] The apparent increase from 1914 to 1915 is in part due to the fact that for the former year the actual number of employees is given and for the latter the number of authorized positions.

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AIDS TO NAVIGATION.

During the fiscal year ended June 30, 1915, there was a net increase of 359 in the total number of aids to navigation maintained by the Lighthouse Service, including 74 lights above the order of minor lights, 1 light vessel, 8 fog signals, 2 submarine bells, 26 daymarks, 25 lighted buoys, 170 unlighted buoys, and 53 minor lights (including 6 float lights).

Fixed lights were changed to flashing or occulting at 29 stations. The illuminant of 21 lights was changed to incandescent oil vapor, the illuminant of 24 lights (including one light vessel) was changed to acetylene, and the illuminant of 3 lights (including one light vessel) was changed to oil gas. Two new light vessels were established during the year. On June 30, 1915, there were maintained by the Lighthouse Service, 14,544 aids to navigation, including 5,155 lights of all classes, and 577 fog signals (not including whistle and bell buoys), of which 50 are submarine signals. It is believed that the systematic methods of improvement and the use of modern apparatus in increasing the number and brilliancy of aids have been of value to the safety of commerce.

The table following gives a summary of the aids to navigation, under each class, established and discontinued during the fiscal year, and also the net increase, and the number in commission at the end of the fiscal years 1914 and 1915:

Class.	1915			Total June 30—	
	Established.	Discontinued.	Increase.	1914 [a]	1915
Lighted aids:					
Lights (other than minor lights)	86	12	74	1,588	1,662
Minor lights	162	115	47	2,790	2,837
Light-vessel stations	1	.....	1	52	53
Gas buoys	54	29	25	454	479
Float lights	14	8	6	118	124
Total	317	164	153	5,002	5,155
Unlighted aids:					
Fog signals	8	.....	8	519	527
Submarine signals	4	2	2	48	50
Whistling buoys, unlighted	3	3	.....	86	86
Bell buoys, unlighted	17	12	5	232	237
Other buoys	354	189	165	6,323	6,488
Day beacons	142	116	26	1,975	2,001
Total	528	322	206	9,183	9,389
Grand total	845	486	359	14,185	14,544

[a] Differences from statistics published in 1914 report are due to minor discrepancies in previous count.

The following are some of the more important aids which have been established or materially improved during the past fiscal year:

New light vessels, with flashing lights and compressed-air fog signals, were established at Poe Reef, Straits of Mackinac, Lake Huron, Mich., and Buffalo Entrance, Lake Erie, N. Y. Both of these were former light-vessel stations, which had been temporarily discontinued, one having been discontinued during the fiscal year.

New light and fog signal stations have been constructed at Brandywine Shoal, Del., and Thimble Shoal, Va., in place of former structures.

A complete new system of lighted aids was established at the approaches to the Cape Cod Canal, Mass.

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Important coast lights changed from fixed to flashing or occulting: Cape Sarichef, Unimak Pass, Alaska; Ediz Hook, Juan de Fuca Strait, Wash.; Diamond Head, Oahu, Hawaii; Fowey Rocks and Sombrero Key, Florida Reefs, Fla.

Fog signals established: Gallups Island, Boston Harbor, Mass. (electric bell); Fort McHenry, Baltimore Harbor, Md. (electric bell); Volusia Bar, St. Johns River, Fla. (bell); Point Blunt and Point Stuart, Angel Island, San Francisco Bay, Cal. (electric sirens). The former third-class reed horn at Stratford Shoal (Middle Ground), Long Island Sound, N. Y., was changed to a first-class automatic siren.

Submarine bells established: South Pass gas and whistling buoy, Mississippi Passes, La.; Frying Pan Shoal gas and whistling buoy, N. C.; Martins Reef Light Vessel, *No. 89*, Lake Huron, Mich.

Important gas buoys established: Buzzards Bay, Mass. (2); Cape Cod Canal approach, Mass. (bell); Cornfield Point, Long Island Sound, Conn. (whistle); Cape Henry, Va. (whistle); Wimble Shoal, north of Cape Hatteras, N. C. (whistle); Fernandina Entrance, Fla.; Smith Shoal, Glama Wreck, and New Ground Rocks, Florida Reefs, Fla. (each with whistle); Point Arenas, Vieques Passage, P. R.; Hein Bank, Juan de Fuca Strait, Wash. (bell); South Channel Columbia River entrance, Oreg. (whistle).

Systems of minor aids and buoyage extensively rearranged or improved in important localities: Hudson River, N. Y.; inland waterway, N. J.; Chincoteague Bay, Va.; Newport News Channel, Va.; inland waterway, Fernandina to St. Johns River, Fla.; Santa Rosa Sound, Fla.; Black Rock Channel, Buffalo Harbor, N. Y.; Klag Bay, Alaska; Grays Harbor, Wash.; Yaquina Bay, Oreg.

Flashing acetylene gas lights established: Stockton Harbor Range, Me. (2 lights); Buzzards Bay, Mass. (12 lights); Egmont Key Range Front, Fla.; North Bank, Cedar Keys, Fla.; Ashtabula Harbor, Ohio (2 lights); Conneaut Breakwater, Ohio; Livingstone Channel, Detroit River, Mich.; Manistique Harbor, Mich.; Saugatuck Harbor, Mich.; Oconto Harbor, Wis.; Rugged Island, Resurrection Bay, Alaska.

The amount of hurricane and ice damage during the fiscal year was relatively small, but a number of unusually heavy winter and spring gales, particularly on the Atlantic coast, damaged various vessels and stations. Among these may be mentioned the Atlantic gales of December 5 to 6, 1914, January 12 to 14, and April 2 to 4, 1915; also the Pacific gale of April 29 to 30, 1915, the total aggregate damage amounting to approximately $50,000.

The systematic relief of all buoys at least once a year was carried out throughout the Service with a greater degree of completeness than in prior years, particularly in those districts where difficulties had been previously experienced on account of the large number of inaccessible buoys.

A systematic plan was developed of keeping records of extinguishment of various types of automatic gas lights, both on fixed and floating aids, with arrangements for reporting the percentage of nights extinguished as compared to the entire period under observation. This is believed useful in compiling information as to the comparative efficiency of various types in service and the degree of reliance which may be placed on such lights.

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Further improvements in publishing notices to mariners were undertaken during the year, by adopting a more concise form, giving only such facts as are of principal interest to the mariner.

The light lists for the Atlantic, Lake, and Pacific coasts were each issued in octavo form, which is believed will increase their usefulness to mariners. Special effort was made to publish the seacoast light lists as soon after the first of the calendar year as possible, and the Lake list was issued immediately prior to the opening of the season of navigation.

New editions of the Regulations for Lighting Bridges, and of the Rules and Regulations Governing Private Aids to Navigation, were issued during the fiscal year.

ALASKA.

The total number of aids to navigation in Alaska, including lights, fog signals, buoys, and daymarks, in commission at the close of the fiscal year ended June 30, 1915, was 338, including 112 lights, representing an increase of 75 lights since June 30, 1910, or 203 per cent. The following table, which gives the total number of aids to navigation on June 30 of each year named, illustrates the progress in establishing aids in the Territory:

Aids.	1910	1911	1912	1913	1914	1915
Lights	37	71	85	93	108	112
Fog signals	9	10	10	10	10	10
Buoys	84	105	132	136	157	167
Daymarks	30	29	38	40	44	49
Total	160	215	265	279	319	338

The act of October 22, 1913, made an appropriation of $115,000 for a light and fog-signal station at or near Cape St. Elias, and an item for the establishment of aids to navigation and the improvement of existing aids in Alaska, in the sum of $60,000, was included in the sundry civil act approved August 1, 1914. Work on both of these objects was started as promptly as conditions would permit, and satisfactory progress on each had been made up to the date of this report.

The act of January 25, 1915, appropriated $250,000 for the new lighthouse tender *Cedar*, urgently needed for the work of the Service in Alaska. The plans and specifications were prepared as quickly as practicable, in order to take advantage of market conditions, and after due advertisement a contract was awarded on May 4, 1915, for the construction of the vessel. In order to care for the work in Alaska properly during the construction of the *Cedar*, the tender *Kukui*, an able seagoing vessel, was transferred from the Hawaiian Islands to Alaska.

The new tender *Fern*, for service in the inside waters of southeastern Alaska, was completed during the fiscal year and immediately assigned to duty.

GUANTANAMO, SAMOA, AND GUAM.

The aids to navigation in the outlying United States territory at Guantanamo Bay, Cuba, the American Samoan Islands, and the island of Guam are maintained under the supervision of the naval

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commandants by means of allotments made from the appropriations for the Lighthouse Service. Reports have been received from naval officers in local charge, indicating that the aids have been properly maintained, at an approximate annual expense as follows: Guantanamo, $3,800; Samoa, $2,100; Guam, $600.

ADMINISTRATION METHODS AND ECONOMIES.

A second conference of lighthouse inspectors, authorized by the Secretary, was held during February, 1915. The program followed the same general lines as last year, and the results are believed beneficial to the Service.

A new edition of the Regulations for the Lighthouse Service was approved by the Department and issued, to take effect October 1, 1914. This edition embodies all changes and amendments made since the edition of 1911. At the close of the fiscal year a new edition of the Instructions to Employees, conforming to the revised Regulations, was in proof.

A study was made of the advisability of extending the practice of partial payments to contractors for work of the Lighthouse Service; this being considered desirable to afford relief from hardships occasioned contractors and at the same time to protect the interests of the Government. As a conclusion, revised rules providing for progress payments for 75 per cent of work done, under suitable restrictions and safeguards, were put in effect.

The practice of systematic inspections of the various lighthouse districts by the general inspector, examiner, and officers of the Bureau, was continued with good results. It is understood that similar methods in other services of the Department have been arranged or contemplated.

The standard method of cost keeping was continued during the fiscal year, and a general summary of results is given under a separate head. It is also understood that this method has served as a pattern for other bureaus and services.

Arrangements were made for supplying the district offices with window envelopes, for use when appropriate, with a view to reducing clerical work and preventing errors in mailing.

Instructions were issued the inspectors in reference to the exchange of blueprints of new devices, methods, etc., among the various district offices, in order that all offices may be kept promptly informed of any desirable improvements or apparatus.

Instructions in reference to the more general use of mileage books for employees when traveling on official business were issued for guidance whenever economy might be thereby secured.

A standard form of letter giving information to prospective applicants for lighthouse keepers and other noneducational positions in the Service was prepared and distributed among the inspectors, for use in answering inquiries on the subject.

In order to facilitate assignment of employees from one lighthouse tender to another, as the interests of the Service require, the Department authorized the regarding of all appointive positions on tenders as in the Lighthouse Service at large, instead of on the particular vessel, as was formerly the case. This will greatly lessen the number of papers required to be prepared when vessels are transferred from one district to another.

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With a view to preliminary training for light keepers prior to their permanent assignment to light stations, arrangements have been made, with the approval of the Department, for the appointment of a few additional keepers for a trial system of general training and instruction for such employees in selected districts.

The custom of issuing lists of spare property available for transfer in all lighthouse districts was continued, with good results.

To comply with the rules of the Interstate Commerce Commission and at the same time obtain the advantage of lower freight rates on empty gas tanks, suitable instructions and labels for the shipping of gas tanks, whether charged or empty, were issued during the year.

Instructions were also given in reference to ordering the smallest size freight cars which will properly accommodate the articles to be shipped, in order to obtain the most economical rates for the Lighthouse Service.

Rules for the preparation of commendatory letters, for the Secretary's signature, in the case of employees performing some signal act in saving life or property, were issued by the Department during the year.

The publication of the monthly Lighthouse Service Bulletin was continued throughout the year, with beneficial results.

The exhibit of the Lighthouse Service at the Panama-Pacific International Exposition at San Francisco was installed, and a brief description of its purpose and nature will be found under a separate head.

COST-KEEPING SYSTEM AND RESULTS.

A standard method of cost keeping has been continued in effect throughout the fiscal year, and reports have been received from all the districts, in which itemized costs of each office, depot, light and fog-signal station, tender, and light vessel are shown separately. The costs of minor lights, daymarks, and lighted and unlighted buoys are shown in groups by various districts, each type of aid to navigation being accounted for separately. In all cases the costs are divided into main headings—maintenance and betterments. The cost of maintenance includes what may be considered fixed charges, such as salaries, rations, fuel, and general expendable supplies. The item of betterments includes repairs, improvements, and new construction, and is further subdivided to show the cost of labor and materials separately for each principal object.

The costs are based on the actual expenditures during the fiscal year, whether of money or supplies. They are checked with the money accounts by taking into consideration the actual cash expenditures and the difference in the value of supplies on hand at the beginning and at the end of the year. The information from this cost-keeping system is useful in preparing estimates, planning work, effecting economies, and comparing the efficiency of different districts, vessels, light stations, apparatus, methods, etc.

A generalized summary of costs for the fiscal year ended June 30, 1915, follows, as derived from this cost-keeping system. Overhead charges, offices, depots, and tender service are stated as separate features in this summary and are not distributed nor included in the costs of aids to navigation.

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Summary of Costs, Lighthouse Service, Fiscal Year Ended June 30, 1915.

[Amounts are stated to nearest even dollar, causing occasional minor discrepancies in totals. Difference from total expenditures reported elsewhere is due to inclusion of Bureau salaries, printing expenses, and adjustment of inventories of articles already in stock.]

TOTAL COSTS OF PRINCIPAL FEATURES.

Feature.	Maintenance expenses.					Betterment expenses.				Grand total.	Per cent.
	Salaries.	Subsistence.	General supplies.	Incidental expenses.	Total.	Repairs and improvements. Labor.	Repairs and improvements. Materials and supplies.	New works.	Total.		
Administration [a]	$334,535		$53,760	$2,549	$390,844					$390,844	7
Distributive charges [b]	816,400	$201,879	436,455	33,068	1,487,802	$117,758	$117,879	$138,445	$374,082	1,861,884	34
Aids to navigation [c]	1,482,894	251,491	381,732	22,808	2,138,901	249,048	484,656	422,671	1,156,377	3,295,300	59
Total	2,633,829	453,370	871,947	58,425	4,017,547	366,806	602,535	561,116	1,530,459	5,548,028	100

TOTAL COSTS OF DETAILED FEATURES.

Offices	$334,535		$84,373	$2,549	$421,457					$421,457	8
Depots	165,097		64,039	22,005	251,141	$39,079	$39,197	$73,477	$151,753	402,894	8
Tenders:											
Large	179,770	$53,178	107,864	2,138	342,950	19,412	19,413	653	39,478	382,428	7
Medium	415,077	130,098	205,103	7,799	758,077	52,155	52,156	64,315	168,626	926,703	16
Small	56,456	18,603	28,836	1,126	105,018	7,112	7,113		14,225	119,243	2
Total	651,303	201,879	341,803	11,063	1,206,045	78,679	78,682	64,968	222,329	1,428,374	25
Light vessels:											
Exposed	161,052	38,823	42,573	1,985	244,433	36,935	36,936		73,871	318,304	6
Moderately exposed	93,927	25,861	20,653	218	140,662	39,736	39,737	1,486	80,959	221,621	4
Relief	59,113	14,813	17,596	461	91,978	7,500	7,501	209	15,210	107,188	2
Lakes	38,094	11,064	7,564	989	57,711	6,233	6,234	38,759	51,226	108,937	2
Total	352,186	90,561	88,386	3,653	534,784	90,404	90,408	40,454	221,266	756,050	14

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Light stations:											
First order	115,256	20,751	30,220	1,328	167,553	17,536	20,958	1,587	40,081	207,634	4
Second order	46,337	8,426	16,480	187	71,425	6,984	10,506	3,361	20,851	92,276	2
Third order	94,790	19,835	36,491	1,295	152,411	22,307	20,438	41,704	84,449	236,860	4
Three and one-half order	21,212	4,065	5,077	78	30,449	7,098	5,223	106	12,427	42,876	1
Fourth order	324,682	64,197	91,199	2,657	482,730	47,135	56,572	114,376	218,083	700,813	12
Total	602,277	117,294	179,467	5,545	904,568	101,060	113,697	161,134	375,891	1,280,459	23
Minor fixed aids:											
Fifth order	90,924	18,687	18,162	101	127,869	6,335	7,537	87	13,959	141,828	3
Sixth order	49,037	9,143	8,160	183	66,522	4,115	10,214	368	14,697	81,219	1
Lens lanterns	72,003	8,088	12,806	165	93,064	7,358	4,285	13,948	25,593	118,657	2
Post lights	220,913	.....	17,064	1,021	238,999	2,804	6,785	4,464	14,053	253,052	5
Other lights	92,842	7,718	35,892	4,373	140,821	23,583	55,350	142,273	221,206	362,027	6
Daymarks, etc	.....	.....	1,301	498	1,799	2,842	2,257	2,275	7,374	9,173	.....
Total	525,719	43,636	93,385	6,341	669,074	47,037	86,428	163,415	296,882	965,956	17
Buoys:											
Lighted	2,712	.....	19,252	2,383	24,347	2,364	121,800	57,668	181,832	206,179	4
Unlighted	.....	.....	1,242	4,886	6,128	8,183	72,323	.....	80,506	86,634	1
Total	2,712	.....	20,494	7,269	30,475	10,547	194,123	57,668	262,338	292,813	5
Grand total	2,633,829	453,370	871,947	58,245	4,017,547	366,806	602,535	561,116	1,530,459	5,548,028	100

[a] Includes offices, except expenses of publications and general freight accounts.
[b] Includes depots and tenders; also items excepted above, charged to supplies.
[c] Includes light vessels, light stations, minor fixed aids, and buoys.

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SUMMARY OF COSTS, LIGHTHOUSE SERVICE, FISCAL YEAR ENDED JUNE 30, 1915—Con.

AVERAGE COSTS OF SELECTED FEATURES.

Average cost of—	Salaries.	Subsistence.	Illuminants.	Fuel.	Other supplies.	Incidentals.	Total maintenance.	Repairs and improvements.	Total.
District office, exclusive of third	$12,252	.....	.....	.....	$2,025	$131	$14,408	.....	$14,408
District depot, exclusive of third	6,831	.....	.....	.....	2,624	922	10,377	$4,616	14,993
Large tender, Pacific	22,612	$5,945	.....	$9,724	4,055	286	42,622	5,458	48,087
Large tender, Atlantic	18,655	5,890	.....	8,025	3,063	213	35,846	3,740	39,587
Medium tender	14,740	4,604	.....	4,865	2,390	277	26,885	3,721	30,606
Exposed light vessel	8,053	1,941	$77	1,197	854	99	12,221	3,693	15,914
Moderately exposed light vessel	4,473	1,231	82	280	622	10	6,698	3,784	10,482
Lake light vessel	3,323	950	105	300	292	22	4,992	1,218	6,210
First-order light stations with powerful fog signals	2,465	430	135	277	248	23	3,578	1,032	4,610
First-order light stations without fog signals	1,800	330	147	110	208	24	2,619	515	3,134
Fourth-order light stations with powerful fog signal	1,430	287	65	272	195	17	2,226	632	2,898
Fourth-order light stations without fog signal	658	131	34	44	99	6	974	295	1,269
Lens lantern	189	21	18	5	11	.....	245	[a] 31	276
Minor light, river districts	90	.....	2	.....	3	.....	95	[a] 1	96
Minor light, other districts	121	.....	11	.....	5	1	138	[a] 14	152
High-pressure acetylene light	36	3	30	2	8	4	83	[a] 157	240
High-pressure acetylene buoy	.....	.....	36	.....	[b] 51	1	88	[a] 15	[c] 103
Low-pressure acetylene buoy	.....	.....	130	.....	[b] 23	.....	152	[a] 22	[c] 174
Oil-gas buoy	.....	.....	32	.....	[b] 21	1	54	[a] 7	[c] 61

[a] Figures do not include cost of establishment of new aids.
[b] Figures include transportation charges of all kinds, such as freight on new buoys, etc.
[c] Figures do not include renewal of appendages.

ENGINEERING AND CONSTRUCTION.

New works of principal importance under special appropriations completed during the fiscal year are as follows: Cape Cod Canal entrance lights, Mass.; Rondout (North Dike), N. Y., light and fog signal; Miah Maull Shoal, N. J., light and fog signal; Brandywine Shoal, Del., light and fog signal; Thimble Shoal, Va., light and fog signal; Cape Fear River lights, below Wilmington, N. C.; Oconto Harbor light, Wis.; Point Arena, Cal., improvement of road.

Other important work in progress at the close of the fiscal year includes Atchafalaya Entrance Channel, La., aids to navigation; Galveston Jetty, Tex., light station; Navassa Island, West Indies, light station; Ashtabula, Lorain, and Cleveland, Ohio, light stations; Ashland, Wis., light and fog signal; Manistique, Mich., light and fog signal, and Cape St. Elias, Alaska, light and fog signal.

Extensive study has been given to the protection of exposed shores of various lighthouse reservations from erosion by the sea, and good results have been obtained in a number of instances, by the judicious location of bulkheads, sea walls, or groins.

A study was also made of the effects of sea water on concrete piles in lighthouse works on the south Atlantic and Gulf coasts, indicating that where a fairly rich mixture is used and the reinforcing rods are set back a proper distance from the outside surface of the pile, and precautions have been observed in manufacturing and curing the piles, the effect of sea water, so far as has been observed, is negligible.

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A new type of single pile pipe beacon, carrying a latticed cage daymark, was developed and several placed in service at a moderate cost.

Careful attention has been given in the matter of designing, to develop permanent and fireproof structures in all cases where available funds will permit.

IMPROVEMENT OF APPARATUS AND EQUIPMENT.

A complete line of oil-engine torches, as described in the report for 1914, has been designed, so as to be suitable for any size or type of oil engine in the Service.

Service tests have been made of spar buoys made from logs cut on lighthouse reservations on the Great Lakes. The quality of the timber is good and a considerable saving in cost has also been effected.

Improvements have been made in connection with electric sirenos to avoid the rising and falling notes and the wearing of the bearings due to continued starting and stopping of the mechanism.

Experimental installations were made of temporary unwatched gas lights for winter use at certain isolated stations on the Great Lakes, permitting the keepers to leave under safer conditions and at the same time giving service to belated mariners after the close of the regular navigation season. Three such installations were in commission in Lake Michigan last winter and gave good results. Consideration will be given to extending this arrangement to other important offshore Lake stations.

A test of a new method of signaling under water by means of a patented device known as an oscillator was made at a light vessel during the year. Further experiments were also conducted along the lines of radio fog signals.

Radio apparatus was ordered for five lighthouse tenders. The equipment was designed and manufactured by the Bureau of Standards, with special reference to the particular duties required by the Lighthouse Service.

A new type of electric flasher for gas lights was developed and placed in service. This device is operated by means of dry cells, which control magnets opening and closing the gas valve, as contacts are made by detachable cams on a master clock. Any desired characteristic may be obtained by the attachment of properly arranged cams.

In order to facilitate the landing of supplies and mail at certain isolated Alaska stations, line-throwing guns, similar to those in use by the Coast Guard, have been installed as part of the station equipment. Experiments are also in progress with reference to the use of this device on board lighthouse tenders, for passing lines to other vessels in heavy weather.

An automatic gas-tank manifold, the object of which is to exhaust the gas successively from tanks arranged in batteries, has been experimentally developed. Except for the difficulty of making all connections perfectly gas-tight, the advantage of this arrangement is very material, since only the tanks which have become entirely exhausted require replacing.

A fog-signal installation, with sirens 900 feet distant from the compressors, has been in successful operation. The blasts are given by pneumatic valves controlled by solenoids, which in turn are ener-

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gized by a battery and the time intervals regulated by a timing device in the power house. The entire installation is in duplicate, and so arranged that either siren may be operated at will by means of switches at the power house.

A two-tank cast-iron breakwater light has been designed, with the object of supporting the lantern and tanks at such heights that waves breaking over the breakwater will have relatively slight effect upon the structure.

In cases where old fog signals have been found deficient in power or distribution of sound, measures have been taken to install duplicate first-class automatic air sirens with double-mouth horns. In other cases of revolving lights, where old wheel chariots have worn out in service, measures to replace them by ball-bearing chariots have been taken.

Service tests have been made of new brands of red paint, particularly in localities where the action of the elements has been found severe, owing to unfavorable conditions of heat and moisture. These tests have been successful and such paints, although higher in cost, give the aids so painted a very conspicuous and bright appearance.

With a view to standardizing the sizes of burners in gas apparatus, various standard combinations of different capacity burners for corresponding diameters of lenses were determined.

A standard 300-pound wrought-iron grapnel anchor, suitable for recovering chain and other articles from overboard, was developed at the general depot.

A study was made of the most practicable method of keeping a card record showing the bearings, local ranges, and other information for service use in accurately locating the positions of buoys and light vessels.

A sound deflector has been installed behind a powerful fog signal at the entrance to the harbor of an important city, and has been found effective in lessening the annoyance of the fog signal to residents.

APPROPRIATIONS AND EXPENDITURES.

The appropriations for the maintenance of the Lighthouse Service for the fiscal year 1916 were $5,164,030, being $12,400 in excess of those for the preceding fiscal year. The estimates for maintenance appropriations for 1916 were divided into one appropriation for general expenses of supplies, repairs, etc., and three appropriations for salaries, with an alternative providing for all maintenance appropriations in a single item. This alternative proposition was not authorized by Congress. It is believed, however, that with this form of appropriation a more economical and efficient administration of the Lighthouse Service could be effected, and in the estimates for the next fiscal year attention has been drawn to the fact that if this consolidation is authorized a reduction of $25,000 in the total estimates may be safely made. The appropriations for special works made for the fiscal year 1916 amounted to $250,000. The average appropriations for special works for the ten preceding years, 1906 to 1915, inclusive, amounted to $877,884.

The detailed estimates for the fiscal year 1917 are given on page 631. The total amount for general maintenance is $177,800 more than the appropriation for the present year. The estimate for the Bureau

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of Lighthouses in Washington is $3,200 more than the appropriation for the preceding year. Estimates for 36 special works have been submitted, aggregating $2,002,300, considering only groups 1 and 2. This is $1,752,300 more than the appropriation for special works for the preceding year, and includes a number of important works for which estimates were submitted last year, but which were not included in the appropriations. The estimates include two new lighthouse tenders, two new light vessels, nine new light and fog-signal stations, three new light stations, three new lighthouse depots, six items for establishing or improving aids in general localities, one item for a new system of harbor or channel lights and other aids, six items for improvements of light or fog-signal stations or of groups of aids to navigation, three items for improvement of lighthouse depots, and one item for light keepers' dwellings.

In selecting and submitting estimates for those special works believed to be most important, there were considered estimates submitted by officers in the various districts for new lighthouse and ship construction aggregating about $5,030,000. Many items not included in the estimates for this year are thought to be meritorious, and the more important of them are included in group 3 of the estimates for special works, submitted for consideration as the resources of the Government permit them to be taken up. Explanation of the necessity for each of the items of special works is included with the estimates.

The tables following give comparisons of appropriations and expenditures for the Lighthouse Service, beginning with the fiscal year 1912 and including the estimates for 1917.

APPROPRIATIONS, LIGHTHOUSE SERVICE, FISCAL YEARS 1912–1916, WITH ESTIMATES FOR 1917.

[The salaries and allowances of officers of the Navy and Army on duty with the Lighthouse Service are not included in this table.]

Item.	Appropriations.					Estimates, 1917.
	1912	1913	1914	1915	1916	
MAINTENANCE.						
Salaries, Bureau of Lighthouses	$64,630	$64,630	$64,510	$64,030	$64,030	$67,230
Salaries of keepers of lighthouses	930,000	930,000	930,000	940,000	940,000	940,000
General expenses, Lighthouse Service	2,569,400	2,609,400	2,750,000	2,775,000	2,775,000	2,840,000
Salaries, lighthouse vessels	1,007,420	957,420	967,420	997,600	1,010,000	1,100,000
Salaries, Lighthouse Service	465,960	475,960	360,000	375,000	375,000	394,600
Total for maintenance	5,037,410	5,037,410	5,071,930	5,151,630	5,164,030	5,341,830
Unexpended balances (obligations estimated)	125,400	73,742	50,734	53,424	.....	.....
SPECIAL WORKS.						
New light and fog-signal stations	700,950	69,000	432,500	63,000	.....	638,500
Light vessels	75,000	380,000	125,000	.....	.....	280,000
Lighthouse tenders	7,000	.....	.....	.....	250,000	170,000
Keepers' dwellings	.....	.....	.....	.....	.....	83,000
Improvement of aids	110,000	77,500	22,600	50,000	.....	526,800
Lighthouse depots	100,000	.....	125,000	23,000	.....	304,000
Total for special works	992,950	526,500	722,600	136,000	250,000	2,002,300
Total maintenance and special works	6,030,360	5,563,910	5,794,530	5,287,630	5,414,030	7,344,130

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EXPENDITURES FROM APPROPRIATIONS, LIGHTHOUSE SERVICE, FISCAL YEARS 1911–1915.

[Actual expenditures, regardless of year of appropriation.]

Expenditures.	1911	1912	1913	1914	1915
For maintenance	$5,046,063	$5,058,049	$5,037,778	$5,166,609	$5,111,121
For special works	414,296	310,885	461,627	538,338	500,516
Total	5,460,359	5,368,934	5,499,405	5,704,947	5,611,637

DEPOTS.

The Lighthouse Service maintains 44 depots in the various districts for the storage and distribution of supplies and for other purposes.

The act of August 1, 1914, contained an appropriation of $23,000 for a new carpenter shop at the general lighthouse depot, Tompkinsville, N. Y., to replace the present frame structure, which is a grave menace in case of fire. Plans for the new structure were prepared and the work advertised, a contract being awarded subsequent to the close of the fiscal year.

Plans for the new lighthouse depot at Charleston, S. C., for which an appropriation was made by the act of October 22, 1913, were prepared, and, after correspondence with the War Department relative to a desired modification of the pierhead line, the necessary permit was obtained and a contract let for the construction of the wharf after the close of the fiscal year.

In the following districts provision should be made for improved depot facilities:

In the second district the present depot at Lovells Island, Boston Harbor, is for a number of reasons unsatisfactory, and Congress has authorized the transfer for this purpose of the old marine-hospital site at Chelsea, Boston. This property is now under lease to private parties. The question of obtaining possession of this or some other suitable site is under consideration, and an estimate is submitted for the construction of this depot.

The depot at Woods Hole, Mass., also in the second district, although well located for the work of the Service in the vicinity, is not as useful as it should be, on account of shallow water around the dock and approaches. Estimates are submitted for dredging the channel and basin around the wharf and for the erection of a brick storehouse to replace the present wooden one. This work was authorized by the act of March 3, 1915, but appropriation has not yet been made.

In the third district estimates are submitted for improvement to the offices and laboratory at the Staten Island Depot.

In the fifth district the present principal depot at Portsmouth, Va., is inadequate both in area and in water front, considering the size of the district and the number of lighthouse vessels to be accommodated. Estimate is submitted, to be considered when resources permit, for enlarging this depot or establishing a new one.

In the eleventh district estimates are submitted for repairs and improvements at the depot at Detroit, Mich.

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The present depot at Milwaukee, Wis., is practically surrounded by coal yards and the coal dust is objectionable. Consideration is being given to obtaining a more suitable site.

In the sixteenth district, which in 1910 was organized as a separate lighthouse district, no permanent arrangement has yet been made for a depot, but temporary space is being rented at Ketchikan. An estimate has been submitted, to be considered by Congress as resources permit, for the purchase of a site and the necessary equipment for a lighthouse depot in Alaska.

In the eighteenth district estimates are submitted, for consideration as resources permit, for repairs and improvements to the Goat Island Depot, Cal.

In the nineteenth district the headquarters of the Lighthouse Service are at Honolulu, and storage facilities are either rented or granted by the courtesy of other branches of the Government. The establishment of a permanent depot in this district would facilitate the work of the Service, and estimates are submitted for that purpose, as well as for making temporary provision pending the establishment of a permanent depot.

LIGHTHOUSE TENDERS.

The tenders of the Service have been employed to good advantage during the year. The 46 vessels which have been in commission have steamed a total of about 469,000 nautical miles in their work of supplying light stations, maintaining the buoyage system, transporting construction materials, and carrying the officers and employees of the Service to their stations or on inspection duty.

Contract was awarded May 4, 1915, for the construction of the first-class seagoing lighthouse tender *Cedar*, for service in Alaska. The contract calls for completion in May, 1916.

The medium-draft tender *Laurel*, for service in the fifth lighthouse district, was completed during the fiscal year and went into commission May 21, 1915.

The small tender *Fern*, for service in the inside waters of the sixteenth lighthouse district, was launched on February 6, 1915, and completed during the fiscal year, proceeding to her station of duty on July 1, 1915.

Contract was awarded on November 6, 1914, for the medium-draft tender *Rose*, for service in the bays and sounds of the seventeenth lighthouse district. Work on the vessel was in progress at the close of the fiscal year.

The use of oil fuel is provided for the new tenders for the Pacific coast.

Authority has been granted extending the use of the appropriation of $200,000 heretofore made for the construction of two tenders, for the construction of two or more tenders for general service, it being thought that additional small tenders may be constructed out of this appropriation.

A light-draft tender and barge has been authorized for use in establishing and maintaining aids along the intercoastal waterways of Texas and Louisiana, but no appropriation for the purpose has as yet been made.

With the increase in the number of aids to navigation and the deterioration of older vessels it will probably be necessary to construct on an average one or two new tenders each year.

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Estimate has been submitted for a new lighthouse tender to replace the present tender *Gardenia*, or for general service, as may be found most desirable, at a cost of $150,000.

Radio apparatus was designed and manufactured by the Bureau of Standards for the tenders *Columbine*, *Cypress*, *Orchid*, *Manzanita*, and *Sequoia*. Installation was made on the *Columbine* and *Cypress*, but deferred on the other vessels owing to insufficiency of funds in the appropriation "Salaries, lighthouse vessels."

The condition of this appropriation also necessitated the laying up of the tender *Lilac* until such time as the shortage may be overcome.

During the fiscal year the following long voyages were made by lighthouse tenders in connection with necessary transfers incident to the work of the service: *Myrtle*, from New York to San Juan, P. R.; *Ivy*, from San Juan to Portsmouth, Va.; *Kukui*, from Honolulu, Hawaii, to Ketchikan, Alaska, via San Francisco and Seattle; and *Columbine*, from Ketchikan to Honolulu, by the same route. In all cases, the vessels were commanded by masters in the Lighthouse Service, and the transfers made without special incident.

The following tenders have either been extensively overhauled or such work has been started during the fiscal year 1915: *Kukui*, *Columbine*, *Pansy*, *Heather*, *Orchid*, *Sumac*, and *Mangrove*. In the repair of vessels particular attention has been given to improvements which increase the comfort of the crew, and alterations with this end in view have been made on several tenders during the fiscal year.

It is probable that during the current year extensive overhaul will be completed or undertaken on the following tenders: *Larkspur*, *Ivy*, *Maple*, *Holly*, and *Jessamine*.

The following was the number of tenders of the Lighthouse Service on June 30 of the years specified, omitting vessels not having regular crews and those less than 50 feet in length: 1910, 51; 1911, 46; 1912, 45; 1913, 44; 1914, 45; 1915, 46. On June 30, 1915, the following was the status of the tenders: In actual service, 40; indefinitely laid up, 1; undergoing repairs, 5.

LIGHT VESSELS.

The Lighthouse Service maintains light vessels on 53 stations and has for this purpose 66 light vessels, of which 13 are relief vessels. Some of these vessels are old, 11 having been built over 50 years ago; one is 66 years old. Some of the older vessels are in a condition which does not warrant extensive repairs.

New light vessels *No. 96* and *No. 98* were completed during the fiscal year. The former was assigned to station at Poe Reef, Lake Huron, Mich., in place of *No. 59*, condemned and sold, and the latter to station at Buffalo Entrance, Lake Erie, N. Y., in place of *No. 82*, lost in the storm of November, 1913.

Light vessels *No. 50* and *No. 59* were sold on April 27, 1915, and October 1, 1914, respectively. These vessels were surveyed and condemned as unserviceable and of no further use to the Service.

Contracts were awarded for the construction of second-class light vessels *No. 101* and *No. 102* on March 6, 1915. *No. 101* is intended for general relief duty on the Atlantic coast, and *No. 102* for station at Southwest Pass Entrance to Mississippi River, La. Good progress had been made by the builder up to the close of the fiscal year.

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Plans are in preparation for the construction of light vessels *No. 99* and *No. 100*.

On account of the deterioration of older vessels it will be necessary to construct one or more new light vessels each year.

Estimate is submitted for new light vessels for general service on the Great Lakes, where they are much needed to replace vessels which must soon be withdrawn from duty.

The work of raising Buffalo Light Vessel *No. 82*, referred to in the report for 1914, was completed after the close of the fiscal year. The original contractor abandoned the work, which was subsequently relet to another contractor, who recovered the vessel successfully on September 17, 1915.

Careful attention has been paid in designing and remodeling light vessels to making all parts of such vessels accessible for cleaning and painting; the use of internal-combustion engines has also been extended, which it is believed will effect an economy in maintenance.

The following light vessels have either been extensively overhauled or such work has been started during the last fiscal year: *No. 34*, Charleston, S. C.; *No. 52*, Fenwick Island Shoal, Del.; *No. 54*, Boston, Mass.; *No. 67*, Umatilla Reef, Wash.; *No. 76*, relief (eighteenth district); *No. 80*, Cape Lookout Shoals, N. C.; *No. 91*, Winter-Quarter Shoals, Va.

It is probable that during the current fiscal year extensive overhaul will be completed or undertaken on the following light vessels: *No. 2*, relief (fifth district); *No. 6*, relief (second district); *No. 49*, Cape Charles, Va.; *No. 55*, Lansing Shoal, Mich.; *No. 56*, North Manitou Shoal, Mich.; *No. 57*, Grays Reef, Mich.; *No. 60*, Eleven-Foot Shoal, Mich; *No. 81*, Heald Bank, Tex.

The following was the total number of light vessels and stations on June 30 of the years named:

Year.	Light vessels.	Light-vessel stations.
1910	68	54
1911	63	51
1912	65	51
1913	67	53
1914	66	52
1915	66	53

Of the present light vessels 35 have self-propelling machinery and 29 are provided only with sail power. Two have no means of propulsion.

On June 30, 1915, the following was the status of the light vessels: Regular vessels on station, 49; relief vessels on station, 4; relief vessels at depots, 2; regular vessels under repair, 4; relief vessels under repair, 6; relief vessels laid up, 1.

COOPERATION.

In accordance with the established custom of the Service, every effort has been continued to consult the needs of maritime interests and to cooperate effectively with other branches of the Government in matters relating to the work of the Lighthouse Service.

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Through cooperation with the passenger steamer lines on Long Island Sound, Conn. and N. Y., regulation of steamer traffic was secured by establishing east-bound and west-bound lanes of travel, the Service providing a special gas and whistling buoy, also a bell buoy, to assist in this work. These arrangements were put into effect during the fall of 1914, and in the opinion of navigators have been satisfactory in reducing the possibility of collision in the vicinity, particularly during fog.

Assistance was given other bureaus of the Department in the design of vessels. A temporary drafting room in the Bureau's office was occupied by Coast Survey officers in charge of such work for that service, with officers of the Lighthouse Service acting in a consulting capacity. At the close of the fiscal year general assistance along the same lines was being extended to the Bureau of Fisheries.

Arrangements have also been made for the repair of vessels belonging to other services of the Department at the general depot, when such work can be conveniently done and other duties at the depot will permit.

Conference was had with the Canadian Department of Marine and Fisheries, with the result that that department is taking measures for the establishment of a light and fog signal at Point Abino, north side of Lake Erie. This will prove a valuable aid to navigation on the Great Lakes.

By Executive order of the President three lighthouse reservations in waters adjacent to Puget Sound, Wash., were set apart as refuges for native birds, under the supervision of the Department of Agriculture.

Under the authority granted by the act of March 3, 1915, arrangements were made with the Forest Service for the reforestation of certain lighthouse reservations on the Great Lakes, where conditions are favorable for the growth of timber, to be used by the Lighthouse Service for spar buoys and other purposes.

Arrangements were made with the Public Health Service for the care and treatment of employees of the Lighthouse Service at marine hospitals and relief stations, upon the same terms as exist for the Army and Navy, under suitable regulations. Arrangements for the vaccination against typhoid fever and smallpox of employees of the Lighthouse Service were also made with the Public Health Service.

Sanitary inspections of various stations and vessels were made by officers of the Public Health Service during the year. While the general sanitary conditions were found to be excellent, valuable suggestions as to improving minor conditions were received.

Cooperation with the United States Engineer officers in charge of river improvements in the river districts has been continued with success. As a result of this work, in the thirteenth and fourteenth districts, a test is being made of caring for the aids by vessels of the Engineer Department.

Arrangements were made to supply the Hydrographic Office of the Navy Department with information relative to drifting buoys recovered in the open sea, for use in the study of currents.

Toward the close of the fiscal year arrangements were being made with the Coast and Geodetic Survey for a supply of charts to be available for sale on selected lighthouse tenders.

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At the request of the Coast and Geodetic Survey, arrangements were made for taking certain slack-water observations and current measurements in the general vicinity of the eastern entrance to Long Island Sound, R. I., Conn., and N. Y.

Cooperation was had during the year with practically all maritime branches of the Government, particularly the Navy Department, in the prompt reporting of all information affecting aids to navigation.

SAVING OF LIFE AND PROPERTY.

During the fiscal year 1915 services in saving of life and property were rendered and acts of heroism performed by employees of the Lighthouse Service on vessels or at stations on 143 occasions, a list of which is given on page 618.

REPORT OF OPEN-MARKET PURCHASES.

In compliance with the act of June 17, 1910, there is submitted separately as a part of this report a list of purchases of materials and supplies for the Lighthouse Service made without obtaining bids under public advertisement, with the reasons for so purchasing.

EXHIBIT AT PANAMA-PACIFIC INTERNATIONAL EXPOSITION.

The Lighthouse Service was allotted approximately 3,300 square feet of space in the north end of the Machinery Building, and the sum of $4,750 from the appropriation for the Government's exhibit as a whole. It was planned to make the exhibit of interest from both a historical and practical point of view.

The historic features included a collection of water colors, painted in 1859, of early light stations on the Pacific; the old 10-pounder cannon used from 1855 to 1857 at Point Bonita, Cal., being the first fog signal on the Pacific coast; the first Fresnel lens imported into this country in 1841 for use at Navesink, N. J., as well as the first lens used on the Pacific coast at Alcatraz, Cal., in 1854; also a collection of old lamps used for burning sperm oil, lard oil, and early plunger and air pressure lamps for kerosene.

From a practical standpoint, the exhibit included 50 enlarged photographs of important lighthouse objects, with models to scale of a number of important light stations and vessels.

A modern flashing lens and lantern, also improved forms of fog-bell strikers and a recent type of compressed-air fog signal, using a 6-inch siren, were shown. Present practice in lamps was illustrated by incandescent-oil-vapor outfits of 35 and 55 millimeter mantles, along with smaller sizes of lens and post lanterns. Typical sizes and types of buoys, such as whistling, bell, cans, and nuns, with ballast balls, sinkers, and anchors were also shown.

The attendants on duty were experienced lighthouse keepers, selected from the Pacific coast districts for details of about three weeks each, and were present in uniform to care for and explain the apparatus.

A medal of honor was awarded the exhibit by the exposition authorities, and silver medals were awarded to those officers who collaborated in the preparation of the exhibit.

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LEGISLATION ENACTED AFFECTING THE LIGHTHOUSE SERVICE.

The following is a summary of special legislation affecting the Lighthouse Service enacted at the second and third sessions of the Sixty-third Congress during the fiscal year 1915.

The following appropriations were made by the act of August 1, 1914: Carpenter shop for the general lighthouse depot, Tompkinsville, N. Y., $23,000; completion of Kilauea Point Light Station, Kauai Island, Hawaii, $3,000; aids to navigation in Alaska, $60,000; and aids to navigation at the entrances to the Cape Cod Canal, Mass., $50,000.

The act of August 22, 1914, authorized the transfer from the Interior Department of approximately 206 acres of land on the Queniult Indian Reservation, near Cape Elizabeth, Wash., to the Department of Commerce for lighthouse purposes, under suitable restrictions in reference to the tribal rights.

The act of January 25, 1915, appropriated $250,000 for a lighthouse tender for general service. This vessel has been named *Cedar*, and will be assigned to duty in Alaska.

The act of March 3, 1915, granted authority for the following purposes:

The use of the unexpended balance of the appropriation of $200,000 heretofore made for two tenders for general service, for the construction of additional tenders for general service.

The transfer of a portion of the Tawas lighthouse reservation, Mich., to the Secretary of the Treasury for purposes of the Coast Guard.

The establishment and maintenance, in the discretion of the Commissioner of Lighthouses, of post-lantern lights and other aids to navigation on Lakes Okechobee and Hicpochee and connecting waterways across the State of Florida and on the Apalachicola River and Chipola cut-off.

Leave of absence for per diem employees who have served 12 consecutive months, under rules prescribed by the Secretary of Commerce.

Cooperation between the Lighthouse Service and the Forest Service in the management of forest land on lighthouse reservations.

Authorizing chief clerks in offices of lighthouse inspectors and persons designated by them to administer oaths to travel accounts or other expenses against the United States, and to administer oaths of office to employees of the Lighthouse Service.

The penalties provided by law for obstruction to or interference with any aid to navigation maintained by the Lighthouse Service are made applicable with equal force and effect to any private aid to navigation lawfully maintained under the private-aids act.

The act of February 17, 1915, appropriated $5,556.70 to reimburse the Southern Transportation Co. for damages to their barge *Antietam*, which was in collision on February 4, 1913, with light vessel *No. 80* in Baltimore Harbor, Md.

The act of March 3, 1915, appropriated $331.70 to reimburse Epps Danley for property lost by him while light keeper at East Pascagoula River Light Station, Miss., during a storm in 1906.

The act of March 4, 1915, appropriated $1,091.41 for the payment of seven claims for damages occasioned by collisions for which vessels of the Lighthouse Service were found to be responsible.

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The following works were authorized by the act of March 3, 1915, at the limits of cost specified, but no appropriation of funds was made: Light at Dog Island, Me., $3,500; improvements at Woods Hole depot, Mass., $50,000; improving aids, Hudson River, N. Y., $100,000; improving aids, Sandy Hook, N. J., $20,000; improving aids, Delaware River, Pa. and Del., $80,000; improving aids, St. Johns River, below Jacksonville, Fla., $66,000; additional aids, Florida Reefs, Fla., $75,000; improving aids, Mississippi River, below New Orleans, La., $50,000; small tender and barge, eighth district, Texas and Louisiana, $20,000; light and fog signal, Conneaut, Ohio, $63,500; improving aids, Toledo Harbor, Ohio, $15,000; improving aids, Fighting Island Channel, Detroit River, Mich., $25,000; light and fog signal, Kellett Bluff, Henry Island, Wash., $40,000; improving aids, entrance to Coquille River, Oreg., $6,000; light and fog signal, Point Vincente, Cal.; $80,000; aids to navigation, Pearl Harbor, Hawaii, $80,000.

SPECIAL LEGISLATION NEEDED.

The following additional legislation for the Lighthouse Service is considered desirable:

The salaries of lighthouse inspectors are, by the act of June 17, 1910, limited to $2,400 a year, except the inspector of the third district, whose salary is fixed at $3,600. The salary of $2,400 is inadequate because of the heavy responsibilities with which the inspector is charged and the technical and business ability required to successfully discharge the duties. The compensation of these positions should be sufficient to bring into and retain in the Lighthouse Service a class of persons fully competent to efficiently conduct such important work. The inspectors should be men of high character and qualifications, including technical knowledge as to engineering and nautical affairs, and should have business ability. It is recommended that the salary of inspectors, except the third, be increased to not to exceed $3,000 a year.

Authority is also requested that the Secretary of Commerce be empowered to exchange rights of way in connection with lighthouse reservations. This is considered desirable for the best interests of the Service, as in many cases the existing rights of way over land leading to lighthouse reservations may, with the authority requested, be exchanged for others, more direct and suitable in character.

Recommendation is made that authority be granted to establish and maintain post-lantern lights and other aids to navigation, out of the annual appropriations for the Lighthouse Service on the Mobile, Tombigbee, Warrior, and Black Warrior Rivers, Ala. The lighting of rivers or inland waters is limited to those specifically authorized by Congress, and such authority has not been granted for the waters specified. These rivers have been extensively improved by the building of locks under the War Department, and an increasing commerce, principally of barges carrying coal, has been developed. Maritime interests in these localities have urged the establishment of aids and investigation by the Lighthouse Service has shown that such action is warranted.

Authority is also requested for making the appropriation, "General expenses, Lighthouse Service," available for the purchase, equipment,

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repair, and operation of motor-propelled vehicles for carrying passengers or freight in the Hawaiian Islands. On account of the prohibition contained in the act of August 1, 1914 (38 Stat., 508), there is no appropriation available for this purpose. Except in the vicinity of Honolulu, travel in those islands is almost exclusively by automobile, and on account of the long distances the expense is very high. It is desired to purchase a motor cycle for the use of foremen and other employees in connection with construction and repair work of the Service, which will effect a material saving in transportation expense and in the time of the employees.

Authority is requested also for extending the benefits of the Public Health Service to lighthouse keepers and assistant lighthouse keepers. The employees in question are mostly employed at isolated places and in many cases their compensation is such as to make it a hardship for them to bear the expense of illness or injury. There is already provision for the care and treatment by the Public Health Service of officers and crews of vessels of the Lighthouse Service, without charge, and it is considered just that the other employees named herein be given the same benefits. The proposed legislation has the approval of the Secretary of the Treasury.

There is great need for provision by law for the retirement of employees of the Lighthouse Service who after long service have lost their ability for active duty by reason of age or disability incident to their work. This is essential to full efficiency in the administration of the Service. In the report for 1912 a statement was given showing the practice in a number of important foreign countries with reference to the pensioning of employees in the respective lighthouse services in common with other civil employees in those countries, from which it appears that a retirement system is in force with favorable results under all of the other governments mentioned.

The statistics as to the various classes of aids to navigation and fuller details on many of the subjects mentioned in this report will be found in the pages following.

Respectfully,

GEORGE R. PUTNAM,
Commissioner of Lighthouses.

To Hon. WILLIAM C. REDFIELD,
Secretary of Commerce.

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STATISTICS AND ESTIMATES.

LIST OF OFFICERS OF THE BUREAU OF LIGHTHOUSES AND THE LIGHTHOUSE DISTRICTS.

OFFICERS OF THE BUREAU OF LIGHTHOUSES ON JUNE 30, 1915.

George R. Putnam.....Commissioner of Lighthouses.
John S. Conway.....Deputy Commissioner.
H. B. Bowerman.....Chief Constructing Engineer.
Edward C. Gillette.....Superintendent of Naval Construction.

Principal Assistant Engineer, Rudolph Zirpel.
Inspector for general duty, E. M. Trott.
Examiner, Thomas Flood.

INSPECTORS IN CHARGE OF LIGHTHOUSE DISTRICTS JULY 1, 1914, TO JULY 1, 1915.

District.	Name.	From—	To—
1st...	C. E. Sherman	July 17, 1911	
2d....	R. H. Goddard	June 27, 1912	
3d....	J. T. Yates	June 20, 1912	
4th...	T. J. Rout	Mar. 1, 1912	
5th...	E. C. Ruland	May 1, 1912	Dec. 21, 1914[a]
	H. D. King	Jan. 28, 1915	
6th...	H. D. King	Apr. 15, 1912	Jan. 27, 1915
	E. L. Beck	Jan. 28, 1915	
7th...	W. W. Demeritt	Aug. 22, 1913	
8th...	B. B. Dorry	June 6, 1912	
9th...	C. A. Lamy	Aug. 7, 1912	
10th..	Roscoe House	June 4, 1912	
11th..	E. L. Woodruff	Aug. 19, 1912	
12th..	L. M. Stoddard	Aug. 16, 1912	
13th..	Maj. George M. Hoffman, Corps of Engineers, U. S. Army	Oct. 16, 1913	
14th..	Lieut. Col. H. Jervey, Corps of Engineers, U. S. Army	Jan. 17, 1911	
15th..	Col. C. McD. Townsend, Corps of Engineers, U. S. Army	Aug. 1, 1912	June 30, 1915
	Maj. Wildurr Willing, Corps of Engineers, U. S. Army	July 1, 1915	
16th..	W. C. Dibrell	Aug. 22, 1913	
17th..	H. L. Beck	July 6, 1911	Jan. 27, 1915
	Robert Warrack	Feb. 1, 1915	
18th..	H. W. Rhodes	July 6, 1912	
19th..	A. E. Arledge	Sept. 3, 1912	

[a] Date of death.

JURISDICTION OF LIGHTHOUSE SERVICE.

The United States Lighthouse Service is charged with the establishment and maintenance of aids to navigation and with all equipment and work incident thereto on the sea and lake coasts of the United States, on the rivers of the United States so far as specifically authorized by law, and on the coasts of all other territory under the jurisdiction of the United States, with the exception of the Philippine Islands and Panama. In the Philippine Islands the lighthouse service is maintained by the insular government and supported entirely out of the revenues of the islands. At Panama the Canal Government has charge of the lighting of the canal and approaches under the general appropriations for the canal.

All the work of establishing and maintaining the aids to navigation under the jurisdiction of the Lighthouse Service is performed directly by that service through district organizations, with the exception of a few minor aids, which are maintained by contract, and the exception of the American Samoan Islands, the island of Guam, and Guantanamo, Cuba, where the aids are maintained under the supervision of the

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naval commandants under allotments made from the appropriations for the Lighthouse Service. The Lighthouse Service also has supervision over the establishment and maintenance of private aids to navigation and the lighting of bridges over navigable waters of the United States.

At the present time the United States assists in the maintenance of but one lighthouse outside of its territory, this being at Cape Spartel, Morocco. This light is maintained in accordance with the convention between Morocco and the United States, Austria, Belgium, Spain, France, Great Britain, Italy, Netherlands, Portugal, and Sweden, in force since March 12, 1867. The lighthouse was constructed at the expense of Morocco, but it is maintained by the other contracting powers. The annual appropriation by the United States for this purpose is $325, and it is not under the control of the Lighthouse Service.

The jurisdiction of the Lighthouse Service over rivers not included in tidewater navigation is restricted to such as are specifically named in the various acts of Congress. These now include practically all the important navigable rivers and lakes of the country.

The following table shows the coast line of the United States and Territories under the jurisdiction of the United States, that designated general coast line being measured by steps of 30 miles, and that designated detailed coast line by steps of 3 miles; there are also given the lengths of the coastal and interior rivers and tributaries so far as they are lighted.

	General coast line.	Detailed coast or channel line.
	Statute miles.	*Statute miles.*
Atlantic and Gulf coasts of the United States	3,480	9,732
Pacific coast of the United States	1,404	3,294
Porto Rico, adjacent United States islands, and Guantanamo	374	449
Great Lakes and connecting waters, United States portion	2,520	4,020
Alaska	7,300	22,654
Hawaiian Islands and Midway Islands	788	1,018
Guam	86	92
American Samoan Islands	76	91
Total coast line under United States Lighthouse Service	16,028	41,350
Coastal rivers on which aids to navigation are maintained by the United States Lighthouse Service (Atlantic and Gulf coasts, 1,374 miles; Pacific coast, 242 miles)	.....	1,616
Interior rivers on which aids to navigation are maintained by the United States Lighthouse Service (Mississippi River, 1,920 miles; Ohio River, 967 miles; Missouri River, 390 miles; other rivers, 949 miles)	.....	4,226
Total coast line and rivers under United States Lighthouse Service	.....	47,192
Philippine Islands (lighted by Philippine Government)	4,080	11,511
Panama Canal Zone (coast line only)	17	40
Total seacoast line under the jurisdiction of the United States (not including Great Lakes and rivers)	17,605	48,881

LIMITS OF LIGHTHOUSE DISTRICTS.

First district.—From the head of navigation on the St. Croix River, Me., the northeastern boundary of the United States, to and including Hampton Harbor, N. H. It embraces all aids to navigation on the seacoast of Maine and New Hampshire, and on all tidal waters between the limits named.

Second district.—From Hampton Harbor, N. H., to Elisha Ledge, off Warren Point, R. I., but not including either the harbor or the ledge. It embraces all aids to navigation on the seacoast and tidal waters of Massachusetts, except on the Taunton River and that part of Mount Hope Bay lying within the State boundary.

Third district.—From Elisha Ledge, off Warren Point, R. I., to Cape May, on the coast of New Jersey, excepting Cape May Lighthouse, and to a point on the coast opposite Rehoboth, Del., excepting Cape Henlopen Lighthouse and Hen and Chickens Shoal. It embraces all aids to navigation on the coasts of Rhode Island, Connecticut, New York, and New Jersey northward of Cape May, including Northeast End, Five-Fathom Bank, and Overfalls light vessels, and McCries Shoal, and on all tidal waters tributary to the sea or Long Island Sound between the limits named, together with the aids on Whitehall Narrows, and on the United States waters of Lakes Champlain and Memphremagog.

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Fourth district.—From and including Cape May Light Station, on the coast of New Jersey, to and including Fenwick Island Light Station on the coast of Delaware. It embraces all aids to navigation on the seacoast of New Jersey and Delaware between the points named, the entrance to Delaware Bay, Delaware Bay and River, and the waters tributary thereto, but does not include McCries Shoal, Overfalls Light Vessel, and the aids to navigation seaward thereof, nor the shoals seaward of Fenwick Island.

Fifth district.—From (but not including) Fenwick Island Light Station, on the coast of Delaware, to and including New River Inlet, N. C. It embraces all aids to navigation off the seacoast of Delaware seaward of Fenwick Island, on the seacoasts of Maryland, Virginia, and North Carolina, between the limits named, all of Chesapeake Bay, the sounds of North Carolina, and tributary waters.

Sixth district.—From (but does not include) New River Inlet, N. C., to and including Hillsboro Inlet Light Station, Fla. It embraces all aids to navigation on the seacoasts, bays, sounds, harbors, rivers, and other tidal waters of North Carolina, South Carolina, Georgia, and Florida between the limits named.

Seventh district.—From a point just south of Hillsboro Inlet Light Station to and including Cedar Keys, Fla. It embraces all aids to navigation on the sea and Gulf coasts of Florida, Florida Keys, and on other waters tributary to the sea and Gulf between the limits named.

Eighth district.—From (but not including) Cedar Keys, Fla., to the southern boundary of Texas. It embraces all aids to navigation on the Gulf coast of the United States and tidal waters tributary to the Gulf between the limits named, together with those on the Mississippi River below and including New Orleans, and on Grand Lake and Lake Chicot.

Ninth district.—The island of Porto Rico and the adjacent islands and other islands and stations ceded to the United States in the West Indies.

Tenth district.—From the mouth of the St. Regis River, St. Lawrence River, N. Y., to the mouth of the Detroit River. It embraces all aids to navigation on the United States shores and waters of Lakes Ontario and Erie and the upper part of the St. Lawrence River and the Niagara River, excepting aids to navigation at the mouth of the Detroit River.

Eleventh district.—From and including all aids to navigation at the mouth of the Detroit River, Mich., to the western end of Lake Superior. It embraces all aids to navigation on the United States shores and waters of Lakes St. Clair, Huron, and Superior, the Detroit River, including the mouth, the St. Clair and St. Marys Rivers, and that part of the Straits of Mackinac lying to the eastward of a line drawn across the straits just to the eastward of Old Mackinac Point Light Station, Mich.

Twelfth district.—Includes all aids to navigation on Lake Michigan, Green Bay, and tributary waters lying west of a line drawn across the Straits of Mackinac just east of Old Mackinac Point Light Station, Mich.

Thirteenth district.—The Mississippi River from the head of navigation to the mouth of the Missouri River; the Minnesota River from the head of navigation to its mouth; the Illinois River from the head of navigation to its mouth; the Osage River from the head of navigation to its mouth; the Gasconade River from the head of navigation to its mouth; the Missouri River from the head of navigation to its mouth; St. Croix River and Lake; Lake Traverse; and includes all aids to navigation within these limits and navigable rivers tributary thereto.

Fourteenth district.—The Ohio River from Pittsburgh, Pa., to Cairo, Ill.; the Tennessee River from the head of navigation to its mouth; the Kanawha River from the head of navigation to its mouth; and embraces all aids to navigation within these limits and navigable rivers tributary thereto.

Fifteenth district.—The Mississippi River from and including the mouth of the Missouri River to New Orleans, La.; the Red River from the head of navigation to its mouth; and includes all aids to navigation within these limits and navigable rivers tributary thereto.

Sixteenth district.—From the boundary between Alaska and the Dominion of Canada to the boundary between Alaska and Siberia. It embraces all aids to navigation on the seacoast, bays, rivers, and other tidal waters of Alaska.

Seventeenth district.—From the boundary between California and Oregon to the northern boundary of the United States. It embraces all aids to navigation on the seacoast of Oregon and Washington, on the United States waters of the Strait of Juan de Fuca, Washington Sound, and the Strait of Georgia, and on the tidal waters tributary to the sea, straits, and sounds between the limits named.

Eighteenth district.—From the boundary between California and Mexico to the boundary between California and Oregon. It embraces all aids to navigation on the seacoast, bays, rivers, and other tidal waters of California.

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Nineteenth district.—Embraces the Hawaiian Islands, the Midway Islands, the island of Guam, and the American Samoan Islands, and includes all aids to navigation in the waters thereof.

LOCATION OF DISTRICT OFFICES OF THE UNITED STATES LIGHTHOUSE SERVICE, WITH ADDRESS OF THE LIGHTHOUSE INSPECTOR.

District.	Address.	District.	Address.
1st.....	Portland, Me., Y. M. C. A. Building.	11th.....	Detroit, Mich., Post Office Building.
2d.....	Boston, Mass., 19 Congress Street.	12th.....	Milwaukee, Wis., Federal Building.
3d.....	Tompkinsville, N. Y.	13th.....	Rock Island, Ill., Federal Building.
4th.....	Philadelphia, Pa., Post Office Building.	14th.....	Cincinnati, Ohio, Customhouse.
5th.....	Baltimore, Md., New Customhouse.	15th.....	St. Louis, Mo., Customhouse.
6th.....	Charleston, S. C., Old Post Office Building.	16th.....	Ketchikan, Alaska.
7th.....	Key West, Fla.	17th.....	Portland, Oreg., Customhouse.
8th.....	New Orleans, La., Customhouse.	18th.....	San Francisco, Cal., Customhouse.
9th.....	San Juan, P. R.	19th.....	Honolulu, Hawaii, McCandless Building.
10th.....	Buffalo, N. Y., Federal Building.		

LIGHTHOUSE DEPOTS MAINTAINED ON JUNE 30, 1915.

[The principal depot of the district is indicated by the larger type.]

District.	Location.	District.	Location.
1st.....	Bear Island, Me.	8th.....	Fort San Jacinto, Galveston, Tex.
	LITTLE DIAMOND ISLAND, ME.		Mobile, Ala.
2d.....	LOVELLS ISLAND, BOSTON, MASS.		PORT EADS, LA.
	Woods Hole, Mass.	9th.....	Culebrita Island, P. R.
3d.....	Absecon, N. J.		Guantanamo Bay, Cuba.
	TOMPKINSVILLE, STATEN ISLAND, N. Y.		SAN JUAN, P. R.
	Goat Island, R. I.	10th.....	BUFFALO, N. Y.
	Juniper Island, Vt.		Erie, Pa.
	New London, Conn.		Maumee Bay, Ohio.
	Tucker Beach, N. J.		Rock Island, N. Y.
4th.....	EDGEMOOR, DEL.		Sandusky Bay (Cedar Point), Ohio.
	Lewes, Del.	11th.....	DETROIT, MICH.
5th.....	Annapolis, Md.		Minnesota Point, Minn.
	Chincoteague, Va.		St. Marys River, Mich.
	Lazaretto Point, Md.	12th.....	Charlevoix, Mich.
	Point Lookout, Md.		Milwaukee, Wis.
	PORTSMOUTH, VA.		ST. JOSEPH, MICH.
	Washington Wharf, D. C.	16th.....	KETCHIKAN, ALASKA.
	Washington, North Carolina.	17th.....	Ediz Hook, Wash.
6th.....	CASTLE PINCKNEY, CHARLESTON, S. C.		TONGUE POINT, OREG.
7th.....	Egmont Key, Fla.	18th.....	GOAT ISLAND, CAL.
	KEY WEST, FLA.	19th.....	HONOLULU, HAWAII.

EXPLANATION OF TABLE ON PAGE 589.

The table of aids to navigation includes all those maintained by the Lighthouse Service, a total of 14,544. On page 605 are given facts regarding the private aids to navigation, 662 in number, maintained under authority. In the statistics, relief light vessels are not counted and duplicate or auxiliary lights and fog signals are not counted, but double lights are counted separately when maintained on distinct structures or for distinct purposes. Buoys for the purpose of marking the positions of light vessels or larger buoys are not counted. Fog signals at light stations or on vessels are counted as separate aids, but not those attached to buoys, except in the case of submarine bells, which are counted as separate signals, whether on vessels or on buoys. Otherwise each buoy is counted only once, and if it is included in a higher class it is not in the lower class. Light-vessel lights are not counted separately.

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AIDS TO NAVIGATION MAINTAINED BY THE UNITED STATES LIGHTHOUSE SERVICE JUNE 30, 1915.

[See note on p. 588.]

Class.	1st dist.	2d dist.	3d dist.	4th dist.	5th dist.	6th dist.	7th dist.	8th dist.	9th dist.	10th dist.	11th dist.	12th dist.	13th dist.	14th dist.	15th dist.	16th dist.	17th dist.	18th dist.	19th dist.	Total.
LIGHTED AIDS.																				
Hyper-radiant lights	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	1
First-order lights	2	5	5	2	8	8	6	3	.....	.....	.....	.....	.....	.....	.....	.....	9	9	.....	57
Second-order lights	7	3	2	.....	.....	2	1	2	1	.....	3	2	.....	.....	.....	.....	.....	1	2	26
Third-order lights	6	1	3	3	.....	3	4	7	6	5	10	9	.....	.....	.....	4	2	4	1	68
Three-and-one-half-order lights	.....	2	1	.....	1	1	.....	3	2	3	6	2	.....	.....	.....	.....	.....	.....	.....	21
Fourth-order lights	34	25	57	11	49	2	4	12	2	22	43	37	.....	.....	.....	4	16	20	8	346
Fifth-order lights	19	15	18	7	22	3	1	13	2	9	16	12	.....	.....	.....	.....	.....	3	1	141
Sixth-order lights	1	5	22	2	8	1	.....	.....	4	12	6	17	.....	.....	.....	.....	.....	.....	.....	78
Range-lens lights	.....	.....	9	11	4	8	.....	.....	.....	4	3	.....	.....	.....	.....	.....	2	.....	.....	41
Reflector lights	2	7	1	14	4	37	2	2	.....	4	24	1	.....	.....	.....	.....	2	.....	.....	100
Lens-lantern lights	11	28	51	14	55	63	44	161	13	34	88	49	.....	.....	.....	64	23	34	37	769
Minor lights	2	17	175	30	270	160	31	79	1	.....	81	8	465	568	663	33	234	16	4	2,837
Electric lights without lens	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	8	3	1	14
Light-vessel stations	1	11	10	.....	8	4	.....	2	.....	.....	5	6	.....	.....	.....	.....	3	2	.....	53
Gas-lighted buoys	5	43	49	11	58	6	5	22	2	29	71	17	.....	.....	.....	.....	7	6	4	335
Gas and whistling buoys	6	3	11	.....	10	7	5	5	.....	.....	1	1	.....	.....	.....	.....	6	8	.....	63
Gas and aerial bell buoys	.....	5	16	4	11	5	3	1	.....	3	11	15	.....	.....	.....	.....	3	4	.....	81
Float lights	.....	.....	.....	.....	2	.....	.....	.....	.....	10	.....	.....	67	37	1	6	.....	.....	1	124
Total	97	170	430	109	510	310	106	312	33	136	368	176	532	605	664	112	315	110	60	5,155
Lights on fixed aids	85	108	344	94	421	288	93	282	31	93	280	137	465	568	663	106	296	90	55	4,499
Lights on floating aids	12	62	86	15	89	22	13	30	2	43	88	39	67	37	1	6	19	20	5	656
Total lighted aids	97	170	430	109	510	310	106	312	33	136	368	176	532	605	664	112	315	110	60	5,155
UNLIGHTED AIDS.																				
Fog signals, engine power	19	21	37	5	15	4	.....	3	.....	10	38	46	.....	.....	.....	9	23	28	.....	258
Fog signals, clock power	37	13	57	7	68	3	.....	13	.....	5	5	9	.....	.....	.....	1	4	9	.....	231
Fog signals, hand power	12	2	3	.....	.....	.....	1	.....	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	20
Fog signals, electric	.....	2	4	.....	2	.....	.....	.....	.....	.....	4	.....	.....	.....	.....	.....	2	4	.....	18
Submarine signals	2	7	9	.....	8	5	.....	3	.....	.....	5	5	.....	.....	.....	.....	4	2	.....	50
Buoys, whistling (unlighted)	20	11	6	.....	1	7	3	9	1	.....	.....	.....	.....	.....	.....	.....	7	18	3	86
Buoys, bell (unlighted)	50	34	57	6	29	7	5	14	3	.....	.....	3	.....	.....	.....	3	10	15	1	237
Buoys, iron	144	77	157	112	282	277	230	171	106	15	25	26	.....	.....	.....	123	132	43	52	1,972
Buoys, spar (wood)	697	557	824	91	921	4	.....	37	.....	162	481	115	424	.....	.....	41	134	25	3	4,516
Daymarks, beacons, etc	187	86	53	2	237	468	156	120	5	.....	5	1	411	60	.....	49	54	27	80	2,001
Total unlighted aids	1,168	810	1,207	223	1,563	775	395	370	115	192	565	205	835	60	.....	226	370	171	139	9,389
Grand total	1,265	980	1,637	332	2,073	1,085	501	682	148	328	933	381	1,367	665	664	338	685	281	199	14,544

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DETAILS AS TO CHARACTERISTICS OF LIGHTS (NOT INCLUDING LIGHT VESSELS).[a]

	1st dist.	2d dist.	3d dist.	4th dist.	5th dist.	6th dist.	7th dist.	8th dist.	9th dist.	10th dist.	11th dist.	12th dist.	16th dist.	17th dist.	18th dist.	19th dist.	Total.
Fixed white:																	
Sixth order and above..	30	29	54	21	59	30	1	24	6	22	29	19	5	6	4	3	342
Lights below the sixth order	2	11	86	19	223	122	37	131	5	5	62	9	31	186	18	16	963
Lighted buoys	....	1	5	....	....	....	....	2	....	2	....	1	3	....	....	....	14
Fixed red:																	
Sixth order and above..	14	12	21	2	12	16	....	6	2	15	35	30	....	....	....	3	168
Lights below the sixth order	5	11	119	16	89	81	27	104	8	14	67	26	3	68	26	10	674
Lighted buoys	....	3	6	....	....	....	....	1	....	8	....	....	2	....	....	1	21
Flashing or occulting:																	
Sixth order and above..	15	16	40	27	20	16	13	9	4	20	35	16	3	22	32	7	295
Lights below the sixth order	7	23	21	9	15	20	13	5	1	15	42	23	64	11	9	16	294
Lighted buoys	11	47	65	15	79	18	13	25	2	32	83	32	1	16	18	4	461
Fixed and flashing, sixth order and above	12	6	3	....	5	3	2	3	5	2	10	14	....	3	1	....	69
Candlepower:																	
50,000 to 190,000	4	4	4	2	4	7	5	5	5	2	7	1	1	1	7	....	59
200,000 to 490,000	....	1	2	1	1	1	2	1	....	....	3	1	....	1	2	1	17
500,000 and over	....	1	1	....	....	....	....	....	....	....	....	....	....	....	....	1	3
Twin light stations	2	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	5
Stations with resident keepers	70	51	112	33	91	24	12	49	17	36	76	75	9	34	40	15	744

DETAILS AS TO ILLUMINANTS OF LIGHTS (NOT INCLUDING LIGHT VESSELS).[a]

	1st dist.	2d dist.	3d dist.	4th dist.	5th dist.	6th dist.	7th dist.	8th dist.	9th dist.	10th dist.	11th dist.	12th dist.	16th dist.	17th dist.	18th dist.	19th dist.	Total.
Incandescent oil vapor	26	24	36	18	19	15	11	11	10	5	36	13	1	25	30	5	285
Oil (wick lamps):																	
Sixth order and above..	45	36	80	22	73	40	1	31	7	41	49	60	7	4	5	8	509
Lights below the sixth order	6	18	193	33	299	203	62	186	13	19	103	30	39	246	33	24	1,512
Lighted buoys	....	....	....	....	....	....	....	....	....	10	....	....	....	....	....	....	10
Acetylene:																	
Sixth order and above..	....	1	1	10	3	9	4	....	....	11	8	3	....	2	1	1	54
Lights below the sixth order	7	23	31	9	15	20	13	54	....	14	15	25	64	7	7	16	320
Lighted buoys	5	17	30	2	12	18	10	4	....	....	15	2	....	12	7	4	138
Oil gas:																	
Lights with mantles	....	....	....	....	....	....	....	....	....	2	56	....	....	....	....	....	58
Lights without mantles	....	....	....	....	13	....	....	....	....	....	1	1	....	....	....	....	15
Lighted buoys with mantles	1	3	22	2	52	....	....	4	....	32	68	29	....	4	7	....	224
Lighted buoys without mantles	5	31	24	11	15	....	3	20	2	....	....	2	....	....	4	....	117
Electric arc:																	
Sixth order and above..	....	....	1	....	....	....	....	....	....	....	....	....	....	....	1	....	2
Lights below the sixth order	....	....	....	....	....	....	....	....	....	....	....	....	....	2	....	1	3
Electric incandescent:																	
Sixth order and above..	....	....	....	....	1	....	2	....	....	....	9	1	....	....	....	....	13
Lights below the sixth order	1	4	2	2	....	....	....	....	1	1	3	2	1	10	8	1	36
Gas (coal), sixth order and above	....	2	....	....	....	1	....	....	....	....	....	1	....	....	....	....	4
Gas (oil), sixth order and above	....	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	1

[a] Does not include the thirteenth, fourteenth, and fifteenth lighthouse (river) districts, in which there are 1,696 lights on fixed aids and 105 lights on floating aids, all of which use kerosene and are fixed.

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DETAILS AS TO LIGHTS ON LIGHT VESSELS.

	1st dist.	2d dist.	3d dist.	5th dist.	6th dist.	8th dist.	10th dist.	11th dist.	12th dist.	17th dist.	18th dist.	Total.
Characteristics as to lights:												
1 fixed white light	....	2	1	....	1	....	....	4	5	....	....	13
2 fixed white lights	....	3	4	2	2	2	....	....	....	2	1	16
1 fixed red light	....	2	....	....	....	....	....	....	1	....	....	3
2 fixed red lights	....	2	....	....	....	....	....	....	....	....	....	2
1 fixed white and 1 fixed red light	....	1	....	3	1	....	....	....	....	1	....	6
1 white flashing, or occulting, and 1 fixed red light	....	....	2	....	....	....	....	....	....	....	....	2
1 white light, flashing or occulting	1	1	2	2	....	....	1	1	....	....	1	9
2 white occulting lights	....	....	1	1	....	....	....	....	....	....	....	2
Illuminants:												
Incandescent oil vapor	....	1	....	....	1	....	....	....	....	....	....	2
Acetylene	1	....	1	1	....	....	....	....	....	....	....	3
Oil (wick)	....	9	4	4	3	2	....	4	6	3	1	36
Oil (wick) and acetylene	....	....	1	....	....	....	....	....	....	....	....	1
Oil (wick) and oil gas with mantle	....	....	1	....	....	....	....	....	....	....	....	1
Oil gas with mantle	....	....	....	2	....	....	....	....	....	....	....	2
Electric arc	....	....	1	....	....	....	....	....	....	....	....	1
Electric incandescent	....	1	2	1	....	....	1	1	....	....	1	7
Illuminating apparatus:												
Fourth order	....	1	....	....	1	....	....	....	....	....	....	2
Reflector	....	4	3	3	2	1	1	2	....	1	....	17
Reflector and lens lantern	....	1	2	....	....	....	....	....	....	....	....	3
Lens lantern	1	5	5	5	1	1	....	3	6	2	2	31

DETAILS AS TO FOG SIGNALS.

Kind and how operated.	1st dist.	2d dist.	3d dist.	4th dist.	5th dist.	6th dist.	7th dist.	8th dist.	10th dist.	11th dist.	12th dist.	16th dist.	17th dist.	18th dist.	Total.
Steam:															
Whistle	9	7	6	....	5	2	....	2	4	31	31	....	4	7	108
Siren	....	1	1	....	....	....	....	....	....	....	....	....	1	1	4
Air:															
Whistle	....	3	....	....	1	1	....	....	....	....	6	1	....	1	13
Siren	2	3	22	1	4	1	....	....	5	7	9	4	7	17	82
Diaphone	....	....	....	....	....	....	....	....	1	....	....	....	....	2	3
Siren (electric)	....	....	....	....	....	....	....	....	....	1	....	....	1	4	6
Reed horn	8	5	8	4	5	....	....	1	....	....	....	4	11	....	46
Submarine bells:															
On light vessels, driven by compressed air	1	6	7	....	7	3	....	2	....	3	4	....	3	2	38
On bottom, electric power	....	....	....	....	....	....	....	....	....	2	1	....	....	....	3
On buoys, operated by sea	1	1	2	....	1	2	....	1	....	....	....	....	1	....	9
Bell:															
Clockwork	37	13	57	7	68	3	....	13	5	5	9	1	4	9	231
Electric	....	3	4	....	2	....	....	....	....	3	....	....	1	....	13
Engine	....	1	....	....	....	....	....	....	....	....	....	....	....	....	1
Hand	12	....	3	....	....	....	....	....	....	1	....	....	....	....	16
Horn:															
Hand	....	2	....	....	....	....	1	....	....	1	....	....	....	....	4
Gun:															
Acetylene	....	....	....	....	....	....	....	....	....	....	....	....	1	....	1
Total	70	45	110	12	93	12	1	19	15	54	60	10	34	43	[a]578

[a] Auxiliary fog signals (75), whistling buoys (149), and bell buoys (318) are not included.

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LIGHTED AIDS, EXCLUSIVE OF LIGHTED BUOYS, IN COMMISSION ON JUNE 30, 1915, USING ILLUMINANTS OTHER THAN LIQUID OIL.

INCANDESCENT OIL-VAPOR LIGHTS (288 LIGHTS).

District.	Location.
1st.....	Avery Rock, Me.
	Baker Island, Me.
	Boon Island, Me.
	Cape Neddick, Me.
	Dice Head, Me.
	Egg Rock, Me.
	Great Duck Island, Me.
	Halfway Rock, Me.
	Isles of Shoals, N. H.
	Libby Islands, Me.
	Matinicus Rock North, Me.
	Matinicus Rock South, Me.
	Monhegan Island, Me.
	Mount Desert, Me.
	Moose Peak, Me.
	Owlshead, Me.
	Petit Manan, Me.
	Portsmouth Harbor (Newcastle), N.H.
	Rockland Breakwater, Me.
	Saddleback Ledge, Me.
	Seguin, Me.
	The Cuckolds, Me.
	Two-Bush Island, Me.
	West Quoddy Head, Me.
	Whaleback, Me.
	Whitehead, Me.
	Wood Island, Me.
2d.....	Boston, Mass.
	Boston Light Vessel, No. 54, Mass.
	Cape Ann North, Mass.
	Cape Ann, South, Mass.
	Cape Cod, Mass.
	Cape Poge, Mass.
	Chatham North, Mass.
	Chatham South, Mass.
	Cuttyhunk, Mass.
	Dumpling Rock, Mass.
	Duxbury Pier, Mass.
	Gay Head, Mass.
	Long Island Head, Mass.
	Minots Ledge, Mass.
	Monomoy Point, Mass.
	Nantucket (Great Point), Mass.
	Nauset Beach, Mass.
	Nobska Point, Mass.
	Plymouth (Gurnet), Mass.
	Plymouth (Gurnet) Beacon, Mass.
	Race Point, Mass.
	Sankaty Head, Mass.
	Tarpaulin Cove, Mass.
	The Graves, Mass.
	West Chop, Mass.
3d.....	Absecon, N. J.
	Barnegat, N. J.
	Beavertail, R. I.
	Block Island North, R. I.
	Block Island Southeast, R.I.
	Chapel Hill, N. J.
	Conover Beacon, N. J.
	Eatons Neck, N. Y.
	Elm Tree Beacon, N. Y.
	Execution Rocks, N. Y.
	Falkner Island, Conn.
	Fire Island, N. Y.
	Great Captain Island, Conn.
	Hereford Inlet, N. J.
	Horton Point, N. Y.
	Little Gull Island, N. Y.
	Ludlam Beach, N. J.
	Montauk Point, N. Y.
	New Dorp, N. Y.
	New London Ledge, Conn.
	North Hook Beacon, N. J.
	Old Field Point, N. Y.
	Pecks Ledge, Conn.
	Plum Island, N. Y.
	Point Comfort, N. J.
	Point Judith, R. I.
	Race Rock, N. Y.
3d	Romer Shoal, N. Y.
	Sandy Hook, N. J.
	Sea Girt, N. J.
	Shinnecock Bay, N. Y.
	Staten Island, N. Y.
	Stratford Shoal (Middle Ground), N.Y
	Tucker Beach, N. J.
	West Bank, N. Y.
	Watch Hill, R. I.
4th.....	Bellevue Range Rear, Del.
	Brandywine Shoal, Del.
	Cape Henlopen, Del.
	Cape May, N. J.
	Delaware Breakwater Range Front, Del.
	Elbow of Cross Ledge, N. J.
	Fenwick Island, Del.
	Fourteen-Foot Bank, Del.
	Harbor of Refuge, Del.
	Listons Range Front, Del.
	Listons Range Rear, Del.
	Mahon River, Del.
	Miah Maull Shoal, N. J.
	Newcastle Range Rear, Del.
	Reedy Island Range Front, Del.
	Reedy Island Range Rear, Del.
	Schooner Ledge Range Rear, Pa.
	Ship John Shoal, N. J.
5th.....	Assateague, Va.
	Bodie Island, N. C.
	Cape Charles, Va.
	Cape Hatteras, N. C.
	Cape Henry, Va.
	Cape Lookout, N. C.
	Cove Point, Md.
	Currituck Beach, N. C.
	Hog Island, Va.
	Hooper Island, Md.
	Ocracoke, N. C.
	Point No Point, Md.
	Sandy Point, Md.
	Sharps Island, Md.
	Smith Point, Va.
	Thimble Shoal, Va.
	Thomas Point Shoal, Md.
	Wolf Trap, Va.
	York Spit, Va.
6th.....	Amelia Island, Fla.
	Cape Canaveral, Fla.
	Cape Fear, N. C.
	Cape Romain, S. C.
	Charleston, S. C.
	Frying-Pan Shoals Light Vessel No. 94, N. C.
	Georgetown, S. C.
	Hillsboro Inlet, Fla.
	Hunting Island, S. C.
	Jupiter Inlet, Fla.
	Mosquito Inlet, Fla.
	St. Augustine, Fla.
	St. Johns River, Fla.
	St. Simon, Ga.
	Sapelo, Ga.
	Tybee, Ga.
7th.....	Alligator Reef, Fla.
	American Shoal, Fla.
	Anclote Keys, Fla.
	Carysfort Reef, Fla.
	Dry Tortugas, Fla.
	Egmont Key, Fla.
	Fowey Rocks, Fla.
	Gasparilla Island, Fla.
	Sand Key, Fla.
	Sanibel Island, Fla.
	Sombrero Key, Fla.
8th.....	Bolivar Point, Tex.
	Cape St. George, Fla.
	Cape San Blas, Fla.
	Matagorda, Tex.

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LIGHTED AIDS, EXCLUSIVE OF LIGHTED BUOYS, IN COMMISSION ON JUNE 30, 1915, USING ILLUMINANTS OTHER THAN LIQUID OIL—Continued.

INCANDESCENT OIL-VAPOR LIGHTS—Continued.

District.	Location.
8th	Pensacola, Fla.
	Sabine Bank, Tex.
	Sabine Pass, La.
	Sand Island Range Front, Ala.
	Ship Shoal, La.
	South Pass Range Rear, La.
	Southwest Pass Range Rear, La.
9th	Arecibo, P. R.
	Cape Rojo, P. R.
	Cape San Juan, P. R.
	Culebrita Island, P. R.
	Mona Island, P. R.
	Muertos Island, P. R.
	Point Borinquen, P. R.
	Point Jiguero, P. R.
	Point Tuna, P. R.
	Port San Juan, P. R.
10th	Braddock Point, N. Y.
	Buffalo, N. Y.
	Cleveland West Breakwater Pierhead, Ohio.
	Dunkirk, N. Y.
	Fairport, Ohio.
11th	Au Sable, Mich.
	Big Bay Point, Mich.
	Cheboygan, Mich.
	Crisp Point, Mich.
	Detroit River, Mich.
	Detour, Mich.
	Devils Island, Wis.
	Duluth Range Rear, Minn.
	Eagle Harbor, Mich.
	Fort Gratiot, Mich.
	Forty-Mile Point, Mich.
	Granite Island, Mich.
	Harbor Beach Harbor of Refuge East Entrance North, Mich.
	Huron Island, Mich.
	La Pointe, Wis.
	Manitou, Mich.
	Marquette, Mich.
	Michigan Island, Mich.
	Middle Island, Mich.
	Outer Island, Mich.
	Passage Island, Mich.
	Point Iroquois, Mich.
	Pointe aux Barques, Mich.
	Port Austin Reef, Mich.
	Portage Lake Ship Canals, Mich.
	Presque Isle, Mich.
	Rock of Ages, Mich.
	Round Island, Mich.
	Spectacle Reef, Mich.
	Split Rock, Minn.
	Stannard Rock, Mich.
	Superior Entry South Breakwater, Wis.
	Tawas, Mich.
	Thunder Bay Island, Mich.
	Two Harbors, Minn.
	Whitefish Point, Mich.
12th	Big Sable, Mich.
	Calumet Harbor, Ill.
	Cana Island, Wis.
	Chicago Harbor, Ill.
	Grand Traverse, Mich.
	Grossepoint, Ill.
	Old Mackinac Point, Mich.
12th	Point Betsie, Mich.
	South Manitou, Mich.
	Sturgeon Bay Canal, Wis.
	Tail Point, Wis.
	Twin River Point, Wis.
	White Shoal, Mich.
16th	Cape Hinchinbrook, Alaska.
17th	Alki Point, Wash.
	Burrows Island, Wash.
	Cape Arago, Oreg.
	Cape Blanco, Oreg.
	Cape Disappointment, Wash.
	Cape Flattery, Wash.
	Cape Meares, Wash.
	Desdemona Sands, Oreg.
	Destruction Island, Wash.
	Ediz Hook, Wash.
	Grays Harbor, Wash.
	Heceta Head, Oreg.
	Mukilteo, Wash.
	New Dungeness, Wash.
	North Head, Wash.
	Patos Islands, Wash.
	Point No Point, Wash.
	Point Wilson, Wash.
	Semiamoo Harbor, Wash.
	Smith Island, Wash.
	Tillamook Rock, Oreg.
	Umpqua River, Oreg.
	West Point, Wash.
	Willapa Bay, Wash.
	Yaquina Head, Oreg.
18th	Ano Nuevo Island, Cal.
	Bonita Point, Cal.
	Cape Mendocino, Cal.
	Carquinez Strait, Cal.
	East Brother Island, Cal.
	Farallon Island, Cal.
	Fort Point, Cal.
	Goat Island, Cal.
	Humboldt, Cal.
	Los Angeles Harbor, Cal.
	Mile Rocks, Cal.
	Piedras Blancas, Cal.
	Pigeon Point, Cal.
	Point Arena, Cal.
	Point Arguello, Cal.
	Point Cabrillo, Cal.
	Point Conception, Cal.
	Point Fermin, Cal.
	Point Hueneme, Cal.
	Point Loma, Cal.
	Point Montara, Cal.
	Point Pinos, Cal.
	Point Reyes, Cal.
	Point Sur, Cal.
	Punta Gorda, Cal.
	Roe Island, Cal.
	St. George Reef, Cal.
	San Luis Obispo, Cal.
	Santa Barbara, Cal.
	Trinidad Head, Cal.
19th	Barbers Point, Hawaii.
	Diamond Head, Hawaii.
	Kilauea Point, Hawaii.
	Makapuu Point, Hawaii.
	Molokai, Hawaii.

ACETYLENE LIGHTS (379 LIGHTS).

1st	Clarks Point, Me.	2d	Bass River West Jetty, Mass.
	Emms Rock, Me.		Billingsgate Island, Mass.
	Fort Scammel Point, Me.		Black Marsh Channel, Mass.
	House Island, Me.		Black Rocks, Mass.
	Portland Light Vessel, No. 74, Me.		Canal Channel, Mass. (12 lights).
	Steele Ledge Monument, Me.		Deacons Pond Jetty, Mass.
	Stockton Harbor Range, Me. (2 lights).		Grassy Island Ledge, Mass.

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LIGHTED AIDS, EXCLUSIVE OF LIGHTED BUOYS, IN COMMISSION ON JUNE 30, 1915, USING ILLUMINANTS OTHER THAN LIQUID OIL—Continued.

ACETYLENE LIGHTS—Continued.

District.	Location.
2d	Middle Ledge, Mass.
	Nantucket East Breakwater, Mass.
	Sandy Point, Mass.
	Upper Turn, Mass.
	White Rocks, Mass.
	Winthrop, Mass.
3d	Block Island Breakwater, R. I.
	Block Island Breakwater Outer Basin, R. I.
	Branford Reef, Conn.
	Centerville, N. J.
	Cold Spring Inlet, N. J.
	Cooks Sedges, No. 13, N. J.
	Cornfield Point Light Vessel No. 48, Conn.
	Fuller Rock, R. I.
	Glencove Breakwater, N. Y.
	Goose Neck Point, No. 11, N. J.
	Great Kills, N. J.
	Great Salt Pond Breakwater, Outer End, R. I.
	Jones Rocks, Conn.
	Junction, N. J.
	Little Silver, No. 9, N. J.
	Low Moor, No. 7, N. J.
	Lower Rocky Point, No. 2, N. J.
	Mill Rock Southerly, N. Y.
	Negro Point, N. Y.
	New London Harbor, Conn.
	Northeast End Light Vessel No. 44, N. J.
	Northwest Point, No. 2A, N. J.
	Pamrapo, N. J.
	Point Judith Harbor of Refuge Main Breakwater East, R. I.
	Point Judith Harbor of Refuge Main Breakwater Center, R. I.
	Point Judith Harbor of Refuge Main Breakwater West, R. I.
	Point Judith Harbor of Refuge East Breakwater, R. I.
	Saltersville, N. J.
	Sands Point, No. 4, N. J.
	Sandy Point Breakwater, Conn.
	Sea Haven, N. J.
	South Hook Beacon, N. J.
	U. S. Dike, Nos. 1 and 3, N. J. (2 lights).
4th	Bellevue Range Front, Del.
	Billingsport Range Front, N. J.
	Cherry Island Range Front, Del.
	Cohansey, N. J.
	Deadman Shoal, N. J.
	Eagle Point Range, N. J. (2 lights).
	East Point, N. J.
	Egg Island, N. J.
	Finns Point Jetty, N. J.
	Grubbs Landing, Del.
	Horseshoe Range West Group Lower Front, Pa.
	Maurice River Range, N. J. (2 lights).
	Mispillion River, Del.
	Salem River Range, N. J. (2 lights).
	Symrna Range, Del. (2 lights).
5th	Alligator River, N. C.
	Battle Creek Shoal, Md.
	Brewerton Channel Range Front, Md.
	Cutoff Channel Range, Md. (2 lights).
	Dividing Creek, Va.
	Fishing Point, Outer, Va.
	Fort McHenry, Md.
	Great Island, N. C.
	Guildford Flats, Va.
	Hack Neck Shoal, Va.
	Inner Middle Ground, N. C.
	Jarvis Point Shoal, Va.
	Manokin River, Md.
	Petersons Point, Md.
	Reeds Hammock, N. C.
5th	St. Pierre Island, Md.
	Winter Quarter Shoal Light Vessel No. 91, Va.
6th	Bald Head, N. C.
	Bloody Point Range, Ga. (2 lights).
	Brickyard Creek, S. C.
	Cape Fear River, N. C. (14 lights).
	Dawho River, S. C. (2 lights).
	Hilton Head Range Rear, S. C.
	Jones Island Range, Ga. (2 lights).
	New Channel Range Front, N. C.
	New Channel Range Front (supplemental), N. C.
	Paris Island Range Front, S. C.
	Tybee Range Front, Ga.
	St. Andrews Sound, Ga.
	Winyah Bay South Jetty, S. C.
7th	Charlotte Harbor, Fla.
	Cut J Range, Fla. (2 lights).
	Eastern Triangle, Fla.
	East Washerwoman Shoal, Fla.
	Egmont Key Range Front, Fla.
	Key West, Fla.
	Mangrove Point, Fla.
	Middle Ground, Fla.
	Mosquito Bank, Fla.
	Nine-Foot Shoal, Fla.
	North Bank, Fla.
	Northwest Bar, Fla.
	Northwest Passage, Fla.
	Peace Creek, Fla.
	Tortugas Harbor, Fla.
	Withlacoochee River, Fla.
8th	Caucus Cut and Pensacola Bay Ranges Rear, Fla.
	Cutoff Channel, Ala. (2 lights).
	Cutoff Channel Range, Ala. (2 lights).
	East Bank, Tex.
	Galveston Bay Channel, Tex. (9 lights).
	Galveston Dike, West End, Tex.
	Galveston Jetty, Tex.
	Galveston North Jetty, Tex.
	Hitchcock Reef, Tex.
	Mobile Ship Channel, Ala. (20 lights).
	Port Arthur Canal, Tex.
	Port Bolivar Range, Tex. (2 lights).
	Sabine Pass Channel, La.
	Sabine Pass Entrance and Inner Ranges, La., (4 lights).
	Sand Island Range Rear (twin), Ala. (2 lights).
	Seabrook, Tex.
	Second Turn, Tex.
	Southwest Pass, East Jetty, La.
	Texas City Channel, Tex. (4 lights).
10th	Ashtabula East Breakwater, Ohio.
	Ashtabula West Breakwater Pierhead, Ohio.
	Carleton Island, N. Y.
	Chaumont Harbor, N. Y.
	Cherry Island, N. Y.
	Cleveland East Entrance, Ohio.
	Cleveland East Pierhead, Ohio.
	Cleveland East Breakwater, Ohio.
	Cleveland East Pier, Ohio.
	Cleveland West Breakwater, Ohio.
	Cleveland West Pier, Ohio.
	Conneaut West Breakwater, Ohio.
	Fairport West Pierhead, Ohio.
	Fairport West Pier, Ohio.
	Horseshoe Reef, N. Y.
	Lorain East Breakwater Pierhead, Ohio.
	Lorain West Breakwater Pierhead, Ohio.
	Niagara River Range, N. Y. (2 lights).
	South Buffalo Pierhead, N. Y.
	Strawberry Island Lower Cut Range, N. Y. (2 lights).

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LIGHTED AIDS, EXCLUSIVE OF LIGHTED BUOYS, IN COMMISSION ON JUNE 30, 1915, USING ILLUMINANTS OTHER THAN LIQUID OIL—Continued.

ACETYLENE LIGHTS—Continued.

District.	Location.
10th	Strawberry Island Upper Cut Range, N. Y. (2 lights).
	Wells Island, N. Y.
11th.....	Au Sable Pierhead, Mich.
	Grand Island, Harbor Range, Mich. (2 lights).
	Gull Rock, Mich.
	Harbor Beach Harbor of Refuge East Entrance South, Mich.
	Peach Island Range, Mich. (2 lights).
	Isle Royal, Mich.
	Livingstone Channel, Mich. (8 lights)
	Portage River Pierhead, Mich.
	Port Wing, East Breakwater, Mich.
	Sturgeon Point, Mich.
	Superior Harbor Basin No. 1, Wis.
	Superior Entry Inner North Breakwater, Wis.
	Superior Entry North Breakwater, Wis.
	Superior Entry Inner South Pierhead, Mich.
12th.....	Bank Point, Mich.
	Chicago Breakwater North, Ill.
	Chicago Breakwater South, Ill.
	Elbow, Wis.
	Frankfort South Pierhead, Mich.
	Grand Haven North Pierhead, Mich.
	Holland Range Front, Mich.
	Indiana Harbor Range, Ind. (2 lights).
	Kenosha Breakwater, Wis.
	Kewaunee North Pierhead, Wis.
	Ludington North Breakwater, Mich.
	Ludington South Breakwater, Mich.
	Manistique West Breakwater, Mich.
	Manitowoc South Breakwater, Wis.
	Michigan City Breakwater, Mich.
	Milwaukee Breakwater, Wis.
	Milwaukee South Pierhead, Wis.
	Muskegon North Pierhead, Mich.
	Oconto Harbor South Pierhead, Wis.
	Petoskey, Mich.
	Racine Pierhead, Wis.
	Saugatuck North Pierhead, Mich.
	Saugatuck South Pierhead, Mich.
	Saunders Point, Mich.
	Sheboygan Breakwater, Wis.
	Squaw Point, Mich.
	Waukegan Breakwater, Wis.
16th.....	Battery Point, Alaska.
	Beauclerc Island, Alaska.
	Blank Island, Alaska.
	Busby Island, Alaska.
	Bushy Island, Alaska.
	Caines Head, Alaska.
	Cape Chacon, Alaska.
	Cape Fanshaw, Alaska.
	Cape St. Elias, Alaska.
	Cape Spencer, Alaska.
	Cape Stephens, Alaska.
	Cape Strait, Alaska.
	Channel Island, Tongass Narrows, Alaska.
	Channel Island, Orca Bay, Alaska.
	Dewey Rocks, Alaska.
	East Clump, Alaska.
	Elrington Passage, Alaska.
	Eye-Opener, Alaska.
	Fairway Island, Alaska.
	Grave Point, Alaska.
	Guard Islands, Alaska.
	Hog Rocks, Alaska.
	Johnstone Point, Alaska.
	Key Reef, Alaska.
16th	Lincoln Rock, Alaska.
	Lone Tree Point, Alaska.
	Lord Rocks, Alaska.
	Mellen Rock, Alaska.
	Middle Rock, Alaska.
	Midway Islands, Alaska.
	Midway Rock, Alaska.
	Mitkof Island, Alaska.
	Ocean Cape, Alaska.
	Petersburg Float, 24, Alaska.
	Pilot Rock, Alaska.
	Point Arden, Alaska.
	Point Ellis, Alaska.
	Point Elrington, Alaska.
	Point Gardner, Alaska.
	Point Helen, Alaska.
	Point Hugh, Alaska.
	Point Retreat, Alaska.
	Point Sherman, Alaska.
	Point Young, Alaska.
	Rocky Island, Alaska.
	Rugged Island, Alaska.
	Seal Island, Alaska.
	Shakan Bay, Alaska.
	Shelter Island, Alaska.
	Ship Island, Alaska.
	Smith Island, Alaska.
	Spanish Islands, Alaska.
	Spire Island Reef, Alaska.
	Strait Island, Alaska.
	Stikine Strait, Alaska.
	Sukoi Islets, Alaska.
	Tenakee Inlet, Alaska.
	Turnabout Island, Alaska.
	Vank Island, Alaska.
	Vichnefski Rock, Alaska.
	Warburton Island, Alaska.
	Whale Island, Alaska.
	Windy Bay, Alaska.
	Woody Island, Alaska.
17th.....	Columbia River Entrance Range, Oreg., Wash. (2 lights).
	Lime Kiln, Wash.
	Lower Sands, Oreg.
	Marrowstone Point, Wash.
	Neah Bay, Wash.
	Peapod Rocks, Wash.
	Turn Rock, Wash.
	Viti Rocks, Wash.
18th.....	Anacapa Island, Cal.
	Ballast Point, Cal.
	La Playa, Cal.
	Light No. 5, Cal.
	Redding Rock, Cal.
	Richardson Rock, Cal.
	San Diego Entrance Range, Cal. (2 lights).
19th.....	Hanapepe, Hawaii.
	Hawea Point, Hawaii.
	Kahala Point, Hawaii.
	Kahului Breakwater, Hawaii.
	Kauiki Head, Hawaii.
	Kaunakakai Range, Hawaii (2 lights).
	Kawaihae, Hawaii.
	Keahole Point, Hawaii.
	Kukuihaele, Hawaii.
	Laau Point, Hawaii.
	Lae o Kokole, Hawaii.
	Laupahoehoe, Hawaii.
	McGregor Point, Hawaii.
	Mahukona, Hawaii.
	Molokini, Hawaii.
	Pauwalu Point, Hawaii.

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LIGHTED AIDS, EXCLUSIVE OF LIGHTED BUOYS, IN COMMISSION ON JUNE 30, 1915, USING ILLUMINANTS OTHER THAN LIQUID OIL—Continued.

ELECTRIC ARC LIGHTS (6 LIGHTS).

District.	Location.	District.	Location.
3rd.....	Ambrose Channel Light Vessel, No. 87, N.Y.	18th.....	Alcatraz Island, Cal.
	Navesink, N. J.	19th.....	Waiakea, Hawaii (no lens).
17th.....	Astoria Range, Oreg. (2 lights; no lens).		

ELECTRIC INCANDESCENT LIGHTS (51 LIGHTS).

1st.....	Kennebunkport Pier, Me. (no lens).	12th.....	Charlevoix North Pierhead, Mich.
2d.....	Canal Breakwater, Mass.		Escanaba, Mich.
	Gallups Island, Mass.		Manistique East Breakwater, Mich.
	Great Harbor Range, Mass. (2 lights).	16th.....	Sitka Harbor, Alaska (no lens).
	Nantucket Shoals Light Vessel, No. 85, Mass.	17th.....	Coquille River Entrance Range, Oreg. (2 lights; no lens).
3d.....	Aunt Phebe Rock, N. Y.		Coquille Upper Channel Range, Oreg. (2 lights; no lens).
	Fire Island Light Vessel, N. Y.		Fort Stevens Wharf, Oreg.
	Goat Island Shoal, R. I.		Linnton Landing, Oreg.
	Overfalls Light Vessel, No. 69, Del.		Point Hudson, Wash.
4th.....	Schuylkill River Range, Pa. (2 lights).		Smith Point, Oreg. (no lens).
5th.....	Diamond Shoal Light Vessel, No. 71, N. C.		Tacoma Waterway, Wash.
	Lazaretto Point, Md.		Whatcom Waterway, Wash.
7th.....	Key West Main Ship Channel Range, Fla. (2 lights).	18th.....	Brosnons Wharf, Cal.
9th.....	Puntilla Point, P. R.		Immigration Station, Cal.
10th.....	Buffalo South Pier, N. Y.		Mare Island Dike, Nos. 4, 8, 14, Cal. (3 lights; no lens).
11th.....	Alpena, Mich.		Point Blunt, Cal.
	Atlantic Point, Mich.		Point Stuart, Cal.
	Center Pierhead, Mich.		San Antonio Creek, Cal.
	Cole Creek, Mich.		San Francisco Light Vessel, No. 70, Cal.
	Duluth Range Front, Mich.		
	Fort Gratiot Range, Mich. (2 lights).		
	Marquette Breakwater, Mich.		
	Osceola Point, Mich.		
	Vidal Shoals Channel Range, Mich. (2 lights).		

GAS LIGHTS (78 LIGHTS).

2d.....	Newburyport Upper Harbor Range, Mass. (2 lights; coal gas).	11th	Grand Marais West Breakwater, Minn. (oil gas).
3d	Scotland Light Vessel, No. 11, N. J. (oil gas).		Grosse Isle South Channel Range, Mich. (2 lights; oil gas).
5th.....	Bush Bluff Light Vessel, No. 97, Va. (oil gas).		Pilgrim Point, Mich. (oil gas).
	Currituck Sound, N. C. (4 lights; oil gas).		Portage Lake Ship Canals, East Breakwater, Mich. (oil gas).
	Fenwick Island Shoal Light Vessel, No. 52, Del. (oil gas).		Portage Lake Ship Canals, West Breakwater, Mich. (oil gas).
	North Landing River, N. C. (5 lights; oil gas).		St. Clair Flats Canal East Pierhead, Mich. (oil gas).
	North River, N. C. (4 lights; oil gas).		St. Marys River, Mich. (45 lights; oil gas).
6th.....	Main Channel Range Rear (St. Phillips Church), S. C. (coal gas).	12th.....	Chicago Outer Breakwater, Northwest End, Ill. (oil gas).
10th.....	Manhattan Range, Ohio (2 lights).		Dunlap Reef Range Front, Wis. (oil gas).
11th.....	Brush Point Range, Mich. (2 lights; oil gas).		North Point (Milwaukee), Wis. (coal gas).
	Ecorse Range Rear, Mich. (oil gas).		

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LIGHTS ESTABLISHED DURING THE FISCAL YEAR 1915.

[230 lights.]

District.	Location.	Order.
1st	Clarks Point, Me.	Minor (acetylene).
	Emms Rock, Me.	Lens lantern (acetylene).
	Fort Scammel Point, Me.	Minor (acetylene).
	Stockton Harbor Range, Me. (2 lights)	Lens lantern (acetylene).
2d	Canal Breakwater, Mass.	Lens lantern (electric).
	Canal Channel, Mass. (12 lights)	Lens lantern (acetylene).
	Deacons Pond Jetty, Mass.	Minor (acetylene).
	Winthrop, Mass.	Do.
3d	Fordham Point North Dyke, N. Y.	Minor.
	Fordham Point South Dyke, N. Y.	Do.
	Rock Landing Range, Conn. (2 lights)	Do
	Stonehouse Bar Dike, N. Y.	Do.
	Stuyvesant Dike, N. Y.	Do.
	Van Wies Point Dike, N. Y.	Do.
4th	Chester Range, Del. (2 lights)	Reflector.
	Deadman Shoal, N. J.	Minor (acetylene).
	Marcus Hook Range, Pa. (2 lights)	Reflector.
	Salem Creek Range Rear, N. J.	Lens lantern (acetylene).
5th	Abel Bay, N. C.	Minor.
	Atlantic, N. C.	Do.
	Barnes Point Shoal, Va.	Do.
	Bath Creek, N. C.	Do.
	Battle Creek Shoal, Md.	Minor (acetylene).
	Carolina City, N. C.	Minor.
	Chincoteague Bay, Va. (5 lights)	Do.
	Clay Island Shoal, Md.	Do.
	Fairview Point, Md.	Do.
	Flowery Gap, N. C.	Do.
	Fort Foote Wharf, Md.	Do.
	Glymont Wharf, Md.	Do.
	Goulds Lump, N. C.	Do.
	Guildford Flats, Va.	Minor (acetylene).
	Hack Neck, Va.	Do.
	Halls Point, N. C.	Minor.
	Herring Island Shoal, Md.	Do.
	Inner Middle Ground, N. C.	Minor (acetylene).
	Jarvis Point Shoal, Va.	Do.
	Manokin River, Md.	Do.
	Morehead City, N. C.	Minor.
	Morehead City Channel, N. C.	Do.
	Newport Marshes Lower, N. C.	Do.
	Occoquan Bay Float, No. 1, Va.	Do.
	Peltiers Creek, N. C.	Do.
	Petersons Point, Md.	Minor (acetylene).
	Pooles Island Range, Md. (2 lights)	Minor.
	Poplar Island Narrows, Md.	Do.
	St. Pierre Island, Md.	Minor (acetylene).
	Spooners Creek, N. C.	Minor.
	Sunken Island, Va.	Do.
	Upper Mud Bar Float, No. 6, Va.	Do.
	Wallace Channel, N. C. (3 lights)	Do.
	Western Channel, N. C.	Do.
	White Stone Point, Md.	Do.
6th	Amelia River, Fla. (5 lights)	Do.
	Barnwell Island Flats, No. 14, Ga.	Do.
	Brickyard Creek, S. C.	Minor (acetylene).
	Dawho River, S. C. (2 lights)	Do.
	Elba Island Flats, No. 11, Ga.	Minor.
	Fig Island Jetty, Ga.	Do.
	Floralbluff, No. 19D, Fla.	Do.
	Fort Oglethorpe, Ga.	Lens lantern.
	Mile Point Lower Range Rear, Fla.	Minor.
	Mile Point Upper Range, Fla. (2 lights)	Do.
	New Channel Range Front, supplemental, N. C.	Minor (acetylene).
	Sawpit Creek, Fla.	Minor.
	South Channel Range Front, supplemental, S. C.	Do.
	The Sisters Entrance Range, Fla. (2 lights)	Do.
7th	Eastern Triangle, Fla.	Minor (acetylene).
	Egmont Key Range Front, Fla.	Lens lantern (acetylene).
	Matanzas Pass, Fla.	Minor.
	North Bank, Fla.	Lens lantern (acetylene).
	Pine Island Sound, Fla. (6 lights)	Minor.
8th	Boggy Bayou, Fla.	Do.
	Cobbs Point, Fla.	Do.
	Four Mile Point, Fla.	Do.
	Galveston Bay Channel Entrance Range, Tex. (2 lights)	Lens lantern (acetylene).
	Galveston Bay Channel, Tex. (3 lights)	Do.
	Hurricane Crossing Range, Fla. (2 lights)	Minor.
	Light No. 8C, Ala.	Lens lantern (acetylene).
	Lower Pritchard Long Point, Fla.	Minor.
	Pass aux Herons Channel, Ala. (4 lights)	Lens lantern.
	Upper Pritchard Long Point, Fla.	Minor.

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LIGHTS ESTABLISHED DURING THE FISCAL YEAR 1915—Continued.

District.	Location.	Order.
9th	Puntilla Point, P. R	Minor (electric).
10th	Ashtabula East Breakwater, Ohio	Lens lantern (acetylene).
	Ashtabula West Breakwater Pierhead, Ohio	Do.
	Buffalo South Pier, N. Y	Lens lantern (electric).
	Cleveland East Entrance, Ohio	Lens lantern (acetylene).
	Conneaut East Pier, Ohio	Lens lantern.
	Conneaut West Breakwater, Ohio	Lens lantern (acetylene).
11th	Center Pierhead, Mich	Reflector (electric).
	Livingstone Channel, Mich. (2 lights)	Lens lantern (acetylene).
	Superior Harbor Basin, No. 1, Wis	Do.
12th	Manistique West Breakwater, Mich	Do.
	Manistique West Pierhead, Mich	Lens lantern.
	Muskegon North Pierhead, Mich	Lens lantern (acetylene).
	Oconto Harbor South Pierhead, Wis	Do.
	Saugatuck North Pierhead, Mich	Do.
13th	12 minor lights	
	10 lighted spar buoys	
14th	2 minor lights	
15th	43 minor lights	
16th	Gray Cliff, Alaska	Minor.
	Inner Point Sophia, Alaska	Lens lantern.
	Rugged Island, Alaska	Lens lantern (acetylene).
	Sitka Harbor, Alaska	No Lens (electric).
	South Flat North End, Alaska	Minor.
17th	Jewett Landing Range, Oreg. (2 lights)	Do.
	Prairie Channel, Oreg	Do.
	Richardson, Wash	Do.
	South Channel Range, Oreg. (2 lights)	Reflector.
	Steamboat Slough, Wash	Minor.
	Tongue Point Channel Range, Oreg. (2 lights)	Do.
	Tongue Point Crossing, Oreg	Do.
	Turn Rock, Wash	Minor (acetylene).
18th	Junction Point, Cal	Minor.
	Point Blunt, Cal	Lens lantern (electric).
	Point Stuart, Cal	Do.
	San Antonio Creek, Cal	Do.
19th	Cabras Island, Guam	Minor.
	Port Apra, Guam	Do.
	Sumay Point, Guam	Do.

LIGHTS WHERE ILLUMINATION WAS IMPROVED DURING THE FISCAL YEAR 1915.

FLASHING OR OCCULTING LIGHTS CHANGED FROM FIXED LIGHTS (29 LIGHTS).

District.	Location.	District.	Location.
2d	Grassy Island Ledge, Mass.	12th	Chicago Breakwater South, Ill.
	Middle Ledge, Mass.		Ludington North Breakwater, Mich.
5th	Dividing Creek, Va.		Squaw Point, Mich.
	Great Island, N. C.	16th	Cape Sarichef, Alaska.
	Brewerton Channel Range Front, Md.		Elrington Passage, Alaska.
6th	Hilton Head Range Front, S. C.	17th	Fort Stevens Wharf, Oreg.
	St. Andrews Sound, Ga.		Lower Sands, Oreg.
7th	East Washerwoman Shoal, Fla.		Point No Point, Wash.
	Fowey Rocks, Fla.	19th	Diamond Head, Hawaii.
	Key West, Fla.		Kawaihae, Hawaii.
	Middle Ground, Fla.		Keahole, Hawaii.
	Mosquito Bank, Fla.		Laupahoehoe, Hawaii.
	Nine-Foot Shoal, Fla.		McGregor Point, Hawaii.
	Sombrero Key, Fla.		Mahukona, Hawaii.
10th	Carleton Island, N. Y.		

INCANDESCENT OIL-VAPOR LIGHTS CHANGED FROM OIL-WICK LIGHTS (21 LIGHTS).

2d	Boston Light Vessel, No. 54, Mass.	11th	La Pointe, Wis.
5th	Thimble Shoal, Va.		Michigan Island, Mich.
6th	Amelia Island, Fla.		Middle Island, Mich.
7th	Gasparilla Island, Fla.		Port Austin Reef, Mich.
10th	Braddock Point, N. Y.		Round Island, Mich.
	Buffalo, N. Y.		Tawas, Mich.
11th	Cheboygan, Mich.	17th	Mukilteo, Wash.
	Crisp Point, Mich.		Point No Point, Wash.
	Devils Island, Wis.		Willapa Bay, Wash.
	Forty-Mile Point, Mich.	19th	Molokai, Hawaii.
	Granite Island, Mich.		

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LIGHTS WHERE ILLUMINATION WAS IMPROVED DURING THE FISCAL YEAR 1915—Continued.

ACETYLENE OR OTHER LIGHTS CHANGED FROM OIL-WICK LIGHTS, ETC. (32 LIGHTS).

District.	Location.	District.	Location.
2d	Grassy Island Ledge, Mass.	11th	Atlantic Point, Mich. (electric).
	Middle Ledge, Mass.		Cole Creek, Mich. (electric).
5th	Bush Bluff Ligh. Vessel, No. 97, Va. (oil gas from electricity).		Fort Gratiot Range, Mich. (2 lights, electric).
	Brewerton Channel Range Front, Md.	12th	Osceola Point, Mich. (electric).
	Dividing Creek, Va.		Chicago Breakwater South, Ill.
	Great Island, N. C.	16th	Squaw Point, Mich.
	Winter-Quarter Shoal Light Vessel, No. 91, Va.	17th	Elrington Passage, Alaska.
			Fort Stevens Wharf, Oreg. (electric).
6th	Hilton Head Range Front, S. C.		Linnton Landing, Oreg. (electric).
	St. Andrews Sound, Ga.	19th	Lower Sands, Oreg.
7th	East Washerwoman Shoal, Fla.		Kawaihae, Hawaii.
	Key West, Fla. (from incandescent oil vapor).		Keahole Point, Hawaii.
			Laupahoehoe, Hawaii.
	Middle Ground, Fla.		McGregor Point, Hawaii.
	Mosquito Bank, Fla.		Mahukona, Hawaii.
	Nine-Foot Shoal, Fla.		
10th	Carleton Island, N. Y.		
	Horseshoe Reef, N. Y.		
	Manhattan Range, Ohio (2 lights, oil gas).		

LIGHTS DISCONTINUED DURING THE FISCAL YEAR 1915.

[102 lights, including float lights.]

District.	Location.	Order.
1st	Moosabec Reach, Me	Minor.
3d	Rock Landing, Conn	Do.
4th	Salem Creek, N. J	Lens lantern (acetylene).
5th	Occoquan Bay, No. 1, Va	Minor.
	Upper Mud Bar, No. 6, Va	Do.
6th	Bull, No. 1, S. C	Do.
	Cowhead Shoal Range, S. C. (2 lights)	Do.
	East Marsh Island, No. 2, S. C	Do.
	Fig Island Range, S. C. (2 lights)	Reflector.
	Little Cumberland Island, Ga	Third.
	Mile Point Cuts A & B Ranges, Fla. (4 lights)	Minor.
	Oglethorpe Range Front, Ga	Do.
	Sisters Rocks, No. 4, S. C	Do.
	West Marsh Island, No. 6, S. C	Do.
7th	Cedar Keys, Fla	Fourth.
8th	Texas City Channel, No. 3, Tex	Lens lantern (acetylene).
10th	Conneaut Harbor Range Front, Ohio	Fifth.
	E. E. Rice Wreck, Ohio	Minor.
11th	Ohio Central Dock, No. 2, Minn	Do.
	Rice Point Channel, No. 1, Minn	Do.
	Stag Island Lower, Mich	Do.
12th	Kalamazoo, Mich	Fifth.
13th	14 minor lights	
	6 lighted spar buoys	
14th	2 minor lights	
15th	46 minor lights	
16th	Smugglers Cove, Alaska	Minor.
17th	Beacon No. 1, Oreg	Do.
	Morgan Wharf, Wash	Do.
	Taylor Sands, Oreg	Do.
	Twin Rocks, Wash	Do.
19th	Honolulu Channel, No. 8, Hawaii	Lens lantern.
	Hole in the Wall, Guam	Minor.

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LIGHTS, EXCLUSIVE OF LIGHTED BUOYS, WHICH WILL PROBABLY BE ESTABLISHED DURING THE FISCAL YEAR 1916.

District.	Location.	Probable date of establishment.	Order.	Illuminant.	Additional keepers or laborers required.
2d	Mattituck, N. Y.	Aug., 1915	Lens lantern.	Acetylene	0
	Rondout, N. Y.	do	Sixth order	Oil wick	0
	Sayville, N. Y.	Oct., 1915	Lens lantern.	Electric incandescent.	0
	Tuckerton, N. J.		Minor (2)	Oil wick	1
4th	Biles Island, N. J.		do	Acetylene	0
	Broadkill Jetty, Del.		Minor	do	0
	Mud Island, Pa.	Aug., 1915	Minor (2)	do	0
	Oldmans Creek, N. J.		do	do	0
	Penn Manor, Pa.		do	do	0
	Raccoon Creek, N. J.	July, 1915	do	do	0
5th	Cherrystone Channel, Va.	do	Minor	Oil wick	0
	New River, N. C.	Sept., 1915	Minor (3)	do	1
	Oyster Creek, N. C.	Aug., 1915	Minor	Acetylene	0
	Slocum Creek, N. C.	Mar., 1916	do	Oil wick	1
6th	Fort Sumter Range Front, S. C.	July, 1915	Range lens	Acetylene	0
7th	Charlotte Harbor, Fla.	Apr., 1916	Lens lantern (2).	Oil wick	0
	Coon Creek, Fla.	Aug., 1915	Minor	Acetylene	0
	Cuts B and D, Tampa Bay, Fla.	May, 1916	Lens lantern (4).	do	0
	Cut G, Tampa Bay, Fla.	Feb., 1916	Lens lantern (2).	Oil wick	0
	Cut H Range Rear, Caloosahatchee River, Fla.	do	Minor	do	0
	Cut K, Tampa Bay, Fla.	Jan., 1916	Lens lantern.	do	0
			Reflector	do	0
	Dredged Cut, Fla.	Apr., 1916	Minor	Acetylene	0
			Reflector	Oil wick	0
	Miami, Fla.	do	Minor (2)	do	0
	Hillsboro Bay, Fla.	May, 1916	Minor (5)	do	0
	Manatee River, Fla.	Mar., 1916	Minor (3)	do	0
	South Bar, Cedar Keys, Fla.	Jan., 1916	Minor	do	0
8th	Calcasieu-Sabine Canal, La. and Tex.	Sept., 1915	Minor (2)	do	1
	Neches River, La.	do	Minor (5)	do	1
	Sabine-Neches Canal, La.	do	Minor (6)	do	1
	Sabine River, La.	do	Minor	do	1
	Texas City Channel, Tex.	do	Lens lantern (6).	Acetylene	0
9th	Cucaracha, P. R.	Oct., 1915	Sixth order	Oil gas	0
	Fajardo Roads, P. R.	Jan., 1916	Minor (2)	Electric incandescent. / Oil gas	1
	Guayanilla, P. R.	June, 1916	do	do	0
	Parse Shoal, P. R.	do	do	do	0
	Playa Cuaba, P. R.	Jan., 1916	do	do	0
10th	Ballast Island, Ohio	Oct., 1915	Lens lantern.	Acetylene	0
	Linda Island, N. Y.	do	do	do	0
11th	Ashland Breakwater, Wis.	Oct., 1915	Fourth order.	Electricity	1
	Livingstone Channel, Mich.	July, 1915	Lens lantern.	Acetylene	0
12th	Manistee South Breakwater, Mich.	Oct., 1915	do	do	0
	Menominee Pierhead, Mich.	Nov., 1915	Reflector	Oil wick	0
	Sheboygan South Pierhead, Wis.	Oct., 1915	Lens lantern.	Acetylene	0
	South Haven Pierhead, Mich.	Sept., 1915	Reflector	Oil wick	0
16th	Akutan Harbor, Alaska.	July, 1915	Minor	do	1
	Anchor Point, Alaska.	Aug., 1915	Lens lantern.	Acetylene	0
	Barlow Islands, Alaska.	Oct., 1915	do	do	0
	Barren Islands, Alaska.	June, 1916	do	do	0
	Beck Island, Alaska.	July, 1915	Minor	Oil wick	1
	Clear Point, Alaska.	Sept., 1915	Lens lantern.	Acetylene	0
	East Chugach, Alaska.	July, 1915	do	do	0
	East Forelands, Alaska.	Aug., 1915	do	do	0
	Flat Island, Alaska.	July, 1915	do	do	0
	Gambier Entrance Reef, Alaska.	May, 1916	Minor	Oil wick	1
	Hawk Inlet East Shoal, Alaska.	Oct., 1915	Lens lantern.	Acetylene	0
	Hawk Inlet Entrance, Alaska.	Sept., 1915	do	do	0
	Kingsmill Point, Alaska.	do	do	do	0
	Lewis Reef, Alaska.	do	do	do	0
	Little Island, Alaska.	Oct., 1915	do	do	0
	Low Point, Alaska.	do	do	do	0
	Marmion Island, Alaska.	do	do	do	0
	McClellan Rock, Alaska.	Sept., 1915	do	do	0
	Middle Point, Alaska.	Aug., 1915	do	do	0
	Moira Rock, Alaska.	Sept., 1915	do	do	0
	Naked Island, Alaska.	do	do	do	0

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LIGHTS, EXCLUSIVE OF LIGHTED BUOYS, WHICH WILL PROBABLY BE ESTABLISHED DURING THE FISCAL YEAR 1916—Continued.

District.	Location.	Probable date of establishment.	Order.	Illuminant.	Additional keepers or laborers required.
16th	Narrow Point, Alaska	Sept., 1915	Lens lantern	Acetylene	0
	Otstoia Island, Alaska	do	do	do	0
	Point Alexander, Alaska	do	do	do	0
	Point Augusta, Alaska	do	do	do	0
	Point Gambier, Alaska	do	do	do	0
	Point McCartey, Alaska	Dec., 1915	do	do	0
	Point St. Albans, Alaska	Nov., 1915	do	do	0
	Popof Reef Float, 1, Alaska	July, 1915	do	do	0
	Race Point, Alaska	Aug., 1915	do	do	0
	Rose Reef, Alaska	Sept., 1915	do	do	0
	Rose Inlet, Alaska	July, 1915	Minor	Oil wick	1
	Sheep Creek, Alaska	Oct., 1915	Lens lantern	Acetylene	0
	Spruce Cape, Alaska	July, 1915	do	do	0
	Tenakee Inlet, Alaska	Sept., 1915	do	Oil wick	0
17th	Apple Cove Point, Wash	Oct., 1915	do	Acetylene	0
	Cape Horn, Oreg	do	Minor	Oil wick	0
	Catching, Oreg	Sept., 1915	do	do	1
	Coalbank, Oreg	do	do	Electric	0
	Coos River, Oreg	do	do	Oil wick	0
	Fashion Reef, Oreg	do	do	do	0
	Flavel Ranges, Oreg. (4 lights)	Oct., 1915	do	Oil wick (2) Electricity (2)	0
	Hamblock, Oreg	Sept., 1915	do	Oil wick	1
	Iceberg Point, Wash	Oct., 1915	Lens lantern	Acetylene	0
	Mailboat Slough, Wash	Nov., 1915	Minor	Oil wick	0
	Oak Bay, Wash	Aug., 1915	do	do	0
	Port Townsend Canal Range, Wash. (2 lights).	do	do	do	0
	Siuslaw River, Oreg	Nov., 1915	do	do	0
	Table Rock, Oreg	Oct., 1915	do	do	0
	Tansy Point Range, Wash. (2 lights)	do	do	do	0
	Washougal Reef, Oreg	do	do	do	0
	Waterman Point, Wash	do	do	Acetylene	0
18th	Redwood Creek Entrance, Cal	do	Lens lantern	Oil wick	0
19th	Hanamanioa Point, Hawaii	June, 1916	do	Acetylene	0
	Kipahulu, Hawaii	do	do	do	0
	Kukii Point, Hawaii	do	do	do	0

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GAS BUOYS ESTABLISHED AND DISCONTINUED DURING THE FISCAL YEAR 1915.

District.	Location.
	ESTABLISHED (54).
1st	Goat Island Ledge, Me.
2d	Alma E. A. Holmes Wreck, Mass.
	Annie E. Perry Wreck, Mass.
	Bumkin Island, 1, Mass.
	Canal Approach Breakwater (bell), Mass.
	Canal Breakwater, 2, Mass.
	Cataumet, 2, Mass.
	Cleveland Ledge, 7, Mass.
	George P. Hudson Wreck (bell), Mass.
	Round Rock Shoal, 2, Mass.
3d	Barge Wreck, R. I.
	Cornfield (whistle), Conn.
	Luther C. Ward Wreck, N. Y.
	Mudscow Wreck, N. Y.
	New Jersey Wreck (bell), N. Y.
	Patience Island, 2½ (bell), R. I.
4th	Chester Range, 2C, N. J.
	Dunlo Wreck (bell), Del.
	Listons Range, 2L, Del.
5th	Brewerton Channel, 7B, 8B, Md. (2).
	Cape Henry, 2 (whistle), Va.
	Claiborne Cut, 1 (bell), Md.
	Cutoff Channel, 14K, Md.
	Elizabeth Palmer Wreck, Del.
	Fort McHenry Channel, 1M, Md.
	James H. Hargrave Wreck, Va.
	Mary S. Ewing Wreck, Md.
	Target Range, 5A, Md.
	Washingtonian Wreck, Del.
	Wimble Shoal, 6 (whistle), N. C.
6th	Fernandina, 2, Fla.
	Frederick W. Day Wreck (bell), S. C.
	Frying-Pan Shoals, 2A, FP (whistle and submarine bell), N. C.
7th	Charlotte Harbor Entrance (bell), Fla.
	Glama Wreck (whistle), Fla.
	Mullet Key, Fla.
	New Ground Rocks, 12 (whistle), Fla.
	North Channel (bell), Fla.
	Smith Shoal, 14 (whistle), Fla.
8th	Aransas Pass (whistle), Tex.
	Theodore Weems Wreck (whistle), La.
9th	Point Arenas, 1, P. R.
11th	Au Sable Point, 5A (bell), Mich.
	Poe Reef, 12 (bell), Mich.
	Round Island, 9, Mich.
	Stag Island Lower, 5, Mich.
12th	Iowa Wreck, Ill.
	Waukegan Shoals, 3 (bell), Ill.
17th	Alden Bank (bell), Wash.
	Hein Bank (bell), Wash.
	South Channel (whistle), Oreg.
18th	Commission Rock, 4, Cal.
	Invincible Rock, 4, Cal.
	DISCONTINUED (29).
2d	Alma E. A Holmes Wreck, Mass.
	Annie E. Perry Wreck, Mass.
	Sandwich Breakwater, 2 (bell), Mass.
	Tenpound Island Ledge, 6A, Mass.
3d	Barge Wreck, R. I.
	Charlemagne Tower Jr. Wreck, N. J.
	Coal Barge Wreck, N. J.
	Luther C. Ward Wreck, N. Y.
	Mudscow Wreck, N. Y.
	New Jersey Wreck (bell), N. Y.
	Patience Island, 2½, R. I.
	Teaser Wreck, N. J.
4th	Dunlo Wreck (bell), Del.
	Listons Range (bell), Del.
5th	Elizabeth Palmer Wreck, Del.
	James H. Hargrave Wreck, Va.
	Mary S. Ewing Wreck, Md.
6th	Frederick W. Day Wreck (bell), S. C.
	Frying-Pan Shoals, 2A, FP (bell), N. C.
10th	Buffalo Light Vessel Station, N. Y.
	Conneaut West Breakwater, 2, Ohio.
	W. C. Richardson Wreck, N. Y.
11th	Chas. S. Price Wreck, Mich.
	Livingstone Channel, 16, 18A, Mich. (2).
	Poe Reef, 12 (bell), Mich.
12th	Waukegan Shoals, 3, Ill.
17th	Clatsop Spit, 12 (bell), Oreg.
18th	Commission Rock, 4, Cal.

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FOG SIGNALS ESTABLISHED, IMPROVED, AND DISCONTINUED DURING THE FISCAL YEAR 1915.

District.	Location.	Character.	
	ESTABLISHED (8).		
2d	Gallups Island, Mass	Bell operated electrically.	
5th	Fort McHenry, Md	Bell operated electrically.	
6th	Volusia Bar, Fla	Bell struck by machinery.	
10th	Buffalo Light Vessel, No. 98, N. Y	1st-class air siren.	
	Buffalo South Pier, N. Y	Bell struck by machinery.	
18th	Inner Harbor, Los Angeles, Cal	Bell struck by machinery.	
	Point Blunt, Cal	Electric siren.	
	Point Stuart, Cal	Electric siren.	
	IMPROVED (14).	*From—*	*To—*
2d	Boston Light Vessel, No. 54, Mass	10-inch air whistle.	1st-class air siren.
	Hedge Fence Light Vessel, No. 41, Mass	10-inch steam whistle.	1st-class air siren.
3d	Stratford Shoal, Conn	3d-class reed horn.	1st-class air siren.
5th	Thimble Shoal, Va	Bell struck by machinery.	3d-class reed horn.
	Lazaretto Point, Md	Bell struck by machinery.	Bell operated electrically.
6th	Martins Industry Light Vessel, No. 1, S. C	12-inch steam whistle.	1st-class air siren.
10th	Buffalo, N. Y	10-inch steam whistle.	Air diaphone.
11th	Manitou, Mich	10-inch steam whistle.	1st-class air siren.
	Poe Reef Light Vessel, No. 96, Mich	6-inch steam whistle.	1st-class air siren.
	Stannard Rock, Mich	10-inch steam whistle.	Electric siren.
17th	Whatcom Waterway, Wash	Electric horn.	Electric siren.
18th	Fort Point, Cal	Air siren.	Air diaphone.
	Point Reyes, Cal	Air siren.	Air diaphone.
	San Luis Obispo, Cal	10-inch steam whistle.	1st-class air siren.

FOG SIGNALS WHICH WILL PROBABLY BE ESTABLISHED DURING THE FISCAL YEAR 1916.

District.	Location.	Character.
2d	Windmill Point, Mass	Bell operated by electricity.
3d	Rondout, N. Y	Bell struck by machinery.
7th	Egmont Key, Fla	Do.
10th	Ashtabula West Breakwater Pierhead, Ohio	Diaphone.
	Cleveland East Entrance, Ohio	Sireno.
	Cleveland West Pierhead, Ohio	Diaphone.
11th	Ashland Breakwater, Wis	Sireno.
	Eagle River Shoals, Mich	Do.
12th	Manistique East Breakwater, Mich	Diaphone.
17th	Point Hudson, Wash	Bell operated by electricity.
18th	San Antonio Creek, Cal	Siren (electric).

SUBMARINE SIGNALS ESTABLISHED AND DISCONTINUED DURING THE FISCAL YEAR 1915.

District.	Location.	District.	Location.
	ESTABLISHED (4).	11th	Martin Reef Light Vessel, No. 89, Mich.
5th	Chesapeake Bay Entrance Gas, Whistling, and Submarine Bell Buoy, 2CB, Va. (operated by action of sea).		DISCONTINUED (2).
6th	Frying-Pan Shoals Gas, Whistling, and Submarine Bell Buoy, 2A, FP, N. C. (operated by action of sea).	2d	Hedge Fence Light Vessel, No. 41, Mass.
8th	South Pass Gas, Whistling, and Submarine Bell Buoy, La. (operated by action of sea).	11th	Bar Point Shoal Light Vessel, No. 62, Mich.

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SUBMARINE SIGNALS IN COMMISSION ON JUNE 30, 1915.

[Unless otherwise stated, these signals are operated by compressed air (50 signals).]

District.	Location.
1st.....	Manana Island Gas, Whistling, and Submarine Bell Buoy, 14M, Me. (operated by action of sea).
	Portland Light Vessel No. 74, Me.
2d.....	Boston Light Vessel No. 54, Mass.
	Great Round Shoal Light Vessel No. 86, Mass.
	Nantucket Shoals Light Vessel No. 85, Mass.
	Peaked Hill Submarine Bell Buoy, 2A, Mass. (operated by action of sea).
	Pollock Rip Light Vessel No. 47, Mass.
	Pollock Rip Slue Light Vessel No. 73, Mass.
	Vineyard Sound Light Vessel No. 41, Mass.
3d.....	Ambrose Channel Light Vessel No. 87, N. Y.
	Barnegat Shoal Gas, Whistling, and Submarine Bell Buoy, 7B, N. J. (operated by action of sea.)
	Brenton Reef Light Vessel No. 39, R.I.
	Cornfield Point Light Vessel No. 48, Conn.
	Fire Island Light Vessel No. 68, N. Y.
	Five-Fathom Bank Light Vessel No. 79, N. J.
	Northeast End Light Vessel No. 44, N. J.
	Overfalls Light Vessel No. 69, Del.
	Point Judith Gas, Whistling, and Submarine Bell Buoy, 2, R. I. (operated by action of sea).
5th.....	Cape Charles Light Vessel No. 49, Va.
	Cape Lookout Shoals Light Vessel No. 80, N. C.
	Chesapeake Bay Entrance Gas, Whistling, and Submarine Bell Buoy, 2CB, Va. (operated by action of sea.)
	Diamond Shoal Light Vessel No. 71, N. C.
	Fenwick Island Shoal Light Vessel No. 52, Del.
	Tail of the Horseshoe Light Vessel No. 46, Va.
	35-Foot Channel Light Vessel No. 45, Va.
	Winter-Quarter Shoal Light Vessel No. 91, Va.
6th.....	Brunswick Light Vessel No. 84, Ga.
	Frying-Pan Shoals Gas, Whistling, and Submarine Bell Buoy, 2A, FP, N. C. (operated by action of sea).
	Frying-Pan Shoals Light Vessel No. 94, N. C.
	Martins Industry Light Vessel No. 1, S. C.
	St. Johns Gas, Whistling, and Submarine Bell Buoy, St. J., Fla. (operated by action of sea).
8th.....	Heald Bank Light Vessel No. 81, Tex.
	South Pass Entrance Gas, Whistling, and Submarine Bell Buoy, La. (operated by action of sea).
	Southwest Pass Light Vessel No. 43, La.
11th.....	Detour Light Station, Mich. (operated electrically from the shore).
	Lake Huron Light Vessel No. 61, Mich.
	Martin Reef Light Vessel, No. 89, Mich.
	Poe Reef Light Vessel No. 96, Mich.
	Whitefish Point Light Station, Mich. (operated electrically from the shore).
12th.....	Eleven-Foot Shoal Light Vessel No. 60 Mich.
	Grays Reef Light Vessel No. 57, Mich.
	Lansing Shoal Light Vessel No. 55, Mich.
	North Manitou Shoal Light Vessel No. 56, Mich.
	White Shoal Light Station, Mich. (operated electrically from lighthouse).
17th.....	Columbia River Light Vessel No. 88, Oreg.
	Orford Reef Gas, Whistling, and Submarine Bell Buoy, 2 OR, Oreg. (operated by action of sea).
	Swiftsure Bank Light Vessel No. 93, Wash.
	Umatilla Reef Light Vessel No. 67, Wash.
18th.....	Blunts Reef Light Vessel No. 83, Cal.
	San Francisco Light Vessel No. 70, Cal.

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PRIVATE AIDS TO NAVIGATION MAINTAINED ON JUNE 30, 1915.

[Under the act of June 20, 1906.]

District.	Lights.	Buoys.		Other unlighted aids.	Fog signals.	Total.
		Lighted.	Unlighted.			
1st			34	3		37
2d	34	5	27	13	1	80
3d	30	1	53	1	2	87
5th	15	4	41	59	3	122
6th			1	19		20
7th	1			20		21
8th	12		17	13		42
9th			1			1
10th	23	1	7		3	34
11th	8	6	64	1		79
12th	44	2	9		6	61
13th		1				1
16th	2		1	3		6
17th	7		12		1	20
18th	17	2			9	28
19th	18	1	2	2		23
Total	211	23	269	134	25	662

BRIDGES OVER NAVIGABLE WATERS LIGHTED ON JUNE 30, 1915.

[Under the act of Aug. 7, 1882, 22 Stat., 309.]

District.	Lighted bridges.	District.	Lighted bridges.	District.	Lighted bridges.
1st	14	8th	254	15th	7
2d	33	9th		16th	
3d	124	10th	59	17th	50
4th	14	11th	53	18th	8
5th	35	12th	214	19th	
6th	52	13th	76		
7th	14	14th	176	Total	1,183

AIDS MAINTAINED UNDER CONTRACT DURING THE FISCAL YEAR 1915.

District.	Name of aids.	Annual cost.
5th	Currituck Sound, N. C. (130 stakes)	$107.25
	Sand Shoal Inlet, Fishermans Inlet, and Magothy Bay, Va. (2 buoys and 22 stakes)	140.00
6th	Little River Inlet, N. C. (4 bar buoys)	1.00
10th	Lake Ontario and the St. Lawrence River, N. Y. (36 buoys)	1,900.00
	Niagara River, N. Y. (50 buoys)	964.50
11th	Superior Bay, St. Louis Bay and River, Wis. and Minn. (30 lights)	1,800.00
12th	Fox River, Wis. (14 spar buoys); Green Bay, Wis. (18 spar buoys)	160.00
16th	Cooks Inlet, Alaska (3 lights)	170.00
	St. Michael Canal and Apoon Pass, Alaska (32 buoys)	338.50
	Norton Sound (11 lights)	662.50
	Orizaba Reef Bell Buoy	90.00
18th	Hookton Channel Range Rear Light, Cal.	1.00
19th	Lahaina Buoy Light, Hawaii	1.00

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LIGHT VESSELS IN COMMISSION DURING THE FISCAL YEAR 1915.

Number.	Station.	District.	Tonnage. Gross.	Tonnage. Net.	When built.	Material of hull.	Dimensions. Length over all.	Dimensions. Breadth.	Dimensions. Depth.	Indicated horsepower (self-propelling).	Regular complement. Officers.	Regular complement. Crew.	Fog signal.	Illuminant.	Cost of repairs made during fiscal year.	Cost of maintenance during fiscal year.	Original cost.	On station. Months.	On station. Days.
							Ft. in.	Ft. in.	Ft. in.										
74	Portland, Me	1	[a] 495	.....	1902	Wood	129 9	28 6	13 0	380	4	8	12" steam whistle [b]	Acet	$4,278	$10,641	$88,896	8	3
3	Shovelful Shoal, Mass	2	140	.....	1852	do	[c] 69 4	23 0	10 0	.....	2	5	Bell or horn	Oil	273	4,618	12,000	12	....
4	Handkerchief, Mass	2	104	.....	1855	do	[c] 77 0	20 0	10 0	.....	2	5	do	do	829	4,998	.....	12	....
5	Cross Rip, Mass	2	104	.....	1864	do	[c] 80 6	21 6	9 0	.....	2	6	8" air whistle	do	581	6,254	.....	12	....
6	Relief	2	120	.....	.....	do	[c] 80 0	24 0	10 0	.....	1	....	Bell	do	2,016	1,821	.....	2	29
9	Hedge Fence, Mass	2	104	.....	1857	do	[c] 81 2	28 2	9 6	.....	2	5	8" air whistle	do	2,718	3,044	19,883	9	7
41	Vineyard Sound, Mass	2	387	.....	1876	do	120 6	26 9	11 0	.....	2	6	First-class air siren [b]	do	216	6,285	33,000	11	25
42	Hen and Chickens, Mass	2	410	.....	1877	do	121 7	26 6	10 6	.....	3	7	10" air whistle	do	5,614	10,439	40,796	8	11
47	Pollock Rip, Mass	2	[a] 470	.....	1891	Comp	120 10	26 6	11 0	.....	4	6	12" steam chime wh. [b]	do	835	8,879	60,000	9	....
54	Boston, Mass	2	310	.....	1892	Steel	118 10	26 0	11 0	150	4	7	First-class air siren [b]	Inc. o. v.	41,659	9,565	62,030	....	3
66	Relief [d]	2	[a] 590	.....	1896	Comp	123 0	28 6	13 0	350	2	6	12" steam chime wh. [b]	El or o	32	7,816	69,282	10	28
73	Pollock Rip Slue, Mass	2	[a] 538	.....	1901	Steel	123 9	28 6	12 9	400	4	8	do. [b]	Oil	1,048	10,395	79,872	11	9
85	Nantucket Shoals, Mass. [d]	2	[a] 683	246	1907	do	135 5	29 0	13 0	380	5	10	12" steam whistle [b]	El. inc.	4,248	15,462	99,000	9	12
86	Great Round Shoal, Mass	2	[a] 683	246	1907	do	135 5	29 0	13 0	380	4	8	do. [b]	Oil	278	11,015	99,000	12	....
90	Relief	2	[e] 685	225	1908	do	135 5	29 6	13 0	400	2	6	12" steam chime wh. [b]	do	982	10,729	107,213	10	26
11	Scotland, N. J	3	320	.....	1853	Wood	[c] 104 0	24 8	11 6	.....	2	6	Bell	Oil gas	1,288	5,693	13,462	10	3
13	Bartlett Reef, Conn	3	155	.....	1854	do	[c] 79 8	21 8	10 4	.....	2	5	do	Oil	1,539	4,741	12,000	9	15
16	Relief	3	260	.....	1854	do	[c] 103 6	22 6	11 0	.....	0	1	First-class air siren, 6" whistle. [b]	do	864	1,202	28,084	5	6
20	do	3	165	.....	1867	do	c81 6	21 6	10 0	.....	0	1	Bell	do	.....	822	25,040	1	28
23	Ram Island Reef, N. Y	3	186	.....	1857	do	[c] 94 2	24 0	9 0	.....	2	5	do	do	168	484	7,500	10	3
39	Brenton Reef, R. I	3	387	.....	1875	do	119 6	26 9	13 0	.....	4	6	12" and 6" steam wh. [b]	do	46	8,711	42,200	12	....
44	Northeast End, N. J	3	197	.....	1882	Iron	115 6	25 0	10 6	.....	4	7	First-class steam siren [b]	Acet	1,441	9,279	50,000	10	24
48	Cornfield Point, Conn	3	[a] 470	.....	1891	Comp	120 10	27 8	12 0	.....	3	7	First-class air siren [b]	do	569	8,290	52,780	11	9
51	Relief	3	283	.....	1892	Steel	118 10	26 9	11 0	135	2	5	12" steam whistle [b]	El. inc.	3,284	8,252	53,325	5	25
68	Fire Island, N. Y	3	[a] 590	204	1897	Comp	122 10	28 6	12 6	350	4	10	12" steam chime wh. [b]	do	1,801	12,714	74,750	9	29
69	Overfalls, Del	3	[a] 590	204	1897	do	122 10	29 6	13 0	350	4	10	do. [b]	do	1,143	12,789	79,500	9	8
79	Five-Fathom Bank, N. J	3	[e] 668	188	1904	Steel	129 0	28 6	12 6	325	4	8	do. [b]	Oil	328	10,725	89,000	11	22
87	Ambrose Channel, N. Y	3	[a] 683	246	1907	do	135 5	29 0	13 0	325	4	10	12" steam whistle [b]	El. arc	1,597	13,000	99,000	10	8
78	Relief	3	[e] 668	188	1904	do	129 0	28 6	12 6	325	2	5	do. [b]	Oil	6,261	7,179	89,030	7	11

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2	Relief	5	210	.....	1849	Wood...	c 98	0	25	0	9	0	.....	1	2	Bell	...do.....	112	2,577	12,402	4	20
45	Thirty-Five Foot Channel, Va.	5	a 401	285	1887	Steel e...	124	6	27	6	12	0	.....	2	6	8" air chime whistle b	...do.....	4,298	5,008	58,500	7	10
46	Tail of the Horseshoe, Va	5	a 401	.....	1887	...do.....	124	6	27	6	12	0	.....	4	6	12" steam whistle b	...do.....	2,039	8,676	60,000	12	....
49	Cape Charles, Va	5	a 470	.....	1890	Comp...	120	10	27	0	14	0	.....	4	6	.....do. b	...do.....	2,398	8,224	57,900	12	....
52	Fenwick Island Shoal, Del	5	a 416	.....	1892	Steel....	118	10	26	6	12	0	180	4	8	First-class air siren b	...do.....	11,384	8,398	62,000	4	....
71	Diamond Shoal, N. C. d	5	a 590	204	1897	Comp...	122	10	28	6	13	0	350	5	10	12" steam chime wh. b	El. inc..	924	12,472	70,700	9	17
72	Relief d	5	a 693	.....	1900	Steel....	123	6	28	6	14	0	350	2	6	.....do. b	...do.....	301	10,850	89,000	9	22
80	Cape Lookout Shoals, N. C	5	a 668	188	1904	...do....	129	0	28	6	12	6	500	4	9	.....do. b	Oil.....	5,047	11,531	85,000	9	13
91	Winter-Quarter Shoals, Va	5	a 685	225	1908	...do....	135	5	29	0	13	0	400	4	8	8" steam chime wh. b	Acet	4,870	9,583	107,213	9	13
97	Bush Bluff, Va	5	87	.....	1876	Comp...	80	6	19	5	12	0	.....	1	2	Bell	Oil gas..	23	1,662	.....	9	1
29	Relief	5	232	150	1864	Wood...	101	0	23	6	10	6	.....	1	2	.....do	Oil.....	.....	2,054	.....	2	29
1	Martins Industry, S. C	6	275	.....	1855	...do....	c 103	0	24	0	13	0	.....	2	8	12" steam whistle b	...do.....	9,414	7,960	.....	9	28
34	Charleston, S. C	6	150	.....	1864	...do....	101	10	23	0	10	0	.....	2	6	8" air chime whistle	...do.....	69	5,789	48,000	9	22
53	Relief d	6	310	.....	1892	Steel....	119	0	26	6	11	0	135	3	5	12" steam whistle b	Acet....	1,499	8,052	61,538	6	21
84	Brunswick, Ga	6	a 583	246	1907	...do....	135	5	29	0	13	0	325	4	8	.....do. b	Oil.....	1,942	11,059	99,000	10	17
94	Frying Pan Shoals, N. C. d	6	a 670	229	1911	...do....	135	6	29	0	13	0	363	4	10	12" steam chime wh. b	Inc. o. v.	1,904	12,402	104,604	11	2
43	Southwest Pass, La	8	191	110	1881	Comp...	118	0	25	0	12	0	.....	4	6	12" steam whistle b	Oil.....	3,506	7,705	50,000	6	13
81	Heald Bank, Tex	8	a 685	188	1904	Steel....	129	0	28	6	12	6	325	4	8	.....do. b	...do.....	2,022	10,500	90,000	7	17
98	Buffalo, N. Y	10	f 195	.....	1915	...do....	101	0	23	6	11	5	100	4	2	First-class air siren	El. inc..	17	2,697	87,025	....	19
61	Lake Huron, Mich	11	105	101	1893	Wood...	87	2	21	0	9	0	.....	3	3	6" steam whistle b	Oil.....	225	4,410	14,098	7	21
62	Bar Point Shoal, Mich	11	105	101	1893	...do....	87	2	21	6	8	0	.....	3	3	.....do. b	...do.....	533	4,507	14,098	7	22
75	Lake St. Clair, Mich	11	160	.....	1802	Steel....	83	9	24	0	4	9	.....	2	2	Bell	...do.....	245	2,971	14,983	7	23
89	Martin Reef, Mich	11	f 205	76	1908	...do....	88	3	21	0	10	0	90	4	2	6" steam whistle	...do.....	383	5,559	37,500	7	11
96	Poe Reef, Mich	11	f 170	.....	1914	...do....	101	0	23	6	11	5	.....	3	3	First-class air siren b	...do.....	360	4,027	71,292	2	6
55	Lansing Shoal, Mich	12	129	100	1891	Wood...	102	8	20	0	9	0	100	4	2	6" steam whistle b	...do.....	2,686	5,350	13,600	7	20
56	North Manitou Shoal, Mich	12	130	101	1891	...do....	102	8	20	0	8	10	100	4	2	.....do. b	...do.....	3,915	5,796	13,600	7	19
57	Grays Reef, Mich	12	130	101	1891	...do....	102	8	20	0	8	10	100	4	2	.....do. b	...do.....	2,824	5,295	13,600	7	19
60	Eleven-Foot Shoal, Mich	12	105	101	1893	...do....	87	2	21	6	8	6	.....	3	3	.....do. b	...do.....	1,637	5,014	13,990	7	16
77	Peshtigo Reef, Wis	12	f 155	.....	1906	Steel....	75	0	21	6	4	0	.....	2	3	8" air chime whistle	...do.....	14	3,655	13,950	7	4
95	Milwaukee, Wis	12	f 368	156	1912	...do....	108	5	23	0	10	2	200	4	5	12" steam whistle	...do.....	577	8,263	74,558	10	9
67	Umatilla Reef, Wash	17	450	364	1897	Comp...	122	7	28	6	13	0	200	4	10	12" steam chime wh. b	...do.....	20,305	1,282	69,750	4	19
88	Columbia River, Oreg	17	a 683	246	1907	Steel....	135	5	29	0	13	0	325	4	10	12" steam whistle b	...do.....	1,593	14,489	99,000	11	14
92	Relief	17	a 685	225	1908	...do....	135	5	29	0	13	0	400	2	5	.....do. b	...do.....	.....	15,839	107,213	10	1
93	Swiftsure Bank, Wash	17	a 685	225	1908	...do....	135	5	29	0	13	0	400	4	11	.....do. b	...do.....	2,326	15,172	107,213	9	29
70	San Francisco, Cal	18	a 590	.....	1897	Comp...	122	10	28	6	13	0	300	4	11	.....do. b	El. inc..	2,232	15,987	79,000	8	2
76	Relief	18	a 578	169	1904	Steel....	129	6	28	8	12	0	400	2	5	.....do. b	Oil.....	207	13,659	90,000	7	26
83	Blunts Reef, Cal	18	a 668	188	1904	...do....	129	0	28	6	13	0	380	4	10	.....do. b	...do.....	4,601	13,278	90,000	8	15

a Displacement (salt water).
b Submarine signal.
c Length between perpendiculars.
d Equipped with radio.
e Wood sheathed.
f Displacement (fresh water).

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TENDERS OF THE LIGHTHOUSE SERVICE IN COMMISSION DURING THE FISCAL YEAR 1915.

Name.	District.	Displacement. Light.[a]	Displacement. Loaded.[b]	When built.	Description.	Material of hull.	Dimensions. Length over all.	Dimensions. Breadth.	Dimensions. Depth.	Mean draft. Light.[a]	Mean draft. Loaded.[b]	Indicated horsepower.	Regular complement. Officers.	Regular complement. Crew.	Miles steamed.	Coal consumed for all purposes.	Cost of repairs.	Cost of maintenance.	Original cost.
		Tons.	*Tons.*				*Feet.*	*Feet.*	*Feet.*	*Ft. in.*	*Ft. in.*					*Tons.*			
Hibiscus	1	803	1,053	1908	Steamer, screw	Steel	190	30	16	10 10	13 0	1,000	6	23	13,366	1,762	$1,868	$35,301	$184,643
Zizania	1	575	643	1888	.....do	...do	161	27	12	8 9	9 6	650	6	19	9,240	1,363	4,021	29,851	48,739
Lilac	1	464	643	1892	.....do	...do	155	27	15	10 0	12 3	800	5	19	12,259	1,223	2,305	29,826	92,125
Anemone	2	803	1,053	1908	.....do	...do	190	30	16	10 10	13 0	1,000	7	23	14,114	2,127	2,149	37,435	191,999
Azalea	2	330	516	1891	.....do	...do	154	25	12	6 6	9 0	400	5	19	11,514	833	1,487	26,717	79,792
Mayflower	2	593	668	1897	.....do	...do	164	30	12	7 4	8 1	650	5	22	9,471	1,357	9,325	29,919	74,872
Daisy	3	61	84	1892	.....do	Wood	80	14	5	4 0	5 0	60	2	4	9,100	153	310	7,046	6,500
Gardenia	3	217	245	1879	.....do	...do	[c]117	20	9	6 0	6 6	200	4	11	8,728	488	1,003	15,948	11,000
John Rodgers	3	455	571	1883	Steamer, side-wheel	Iron	160	27	9	6 6	7 9	260	4	16	7,268	734	1,669	20,859	59,987
Larkspur	3	738	888	1903	Steamer, screw	Steel	169	30	14	9 1	10 6	750	6	22	13,687	2,120	1,086	30,960	123,259
Mistletoe	3	455	476	1872	Steamer, side-wheel	Wood	160	26	9	6 9	7 0	370	4	16	7,692	692	1,545	18,868	45,833
Pansy	3	431	454	1878	Steamer, screw	Iron	152	25	11	7 7	7 11	250	4	17	18	62	10,787	14,685	48,739
Tulip	3	803	1,053	1908	.....do	Steel	190	30	16	10 10	13 0	1,000	7	24	16,483	2,216	4,020	36,526	191,658
Iris	4	519	606	1897	.....do	...do	153	30	10	8 7	9 6	800	4	19	11,873	1,367	3,094	26,202	84,407
Woodbine	4	85	107	1913	Oil, screw	Wood	95	16	7	5 2	5 11	125	2	4	11,654	[d]18	1,889	8,502	24,728
Holly	5	431	499	1881	Steamer, side-wheel	Comp	176	24	10	7 0	8 6	400	4	16	9,955	732	1,075	20,667	41,911
Ivy	5	736	916	1904	Steamer, screw	Steel	173	30	13	7 11	9 6	700	5	22	10,419	1,833	6,540	30,414	123,860
Jessamine	5	369	427	1881	Steamer, side-wheel	Iron	156	24	10	7 3	8 1	350	4	16	8,062	753	3,363	20,150	41,911
Juniper	5	125	146	1903	Steamer, screw	Steel	95	18	8	4 6	5 0	290	2	5	11,305	578	563	9,238	29,425
Laurel	5	218	233	1915	.....do	Wood	105	22	9	6 1	6 4	160	4	8	385	9	115	2,762	55,502
Maple	5	567	799	1893	.....do	Steel	164	30	12	7 3	9 5	650	6	22	13,397	1,333	3,106	29,625	93,889
Orchid	5	803	1,053	1908	.....do	...do	190	30	16	10 10	13 0	1,000	6	23	14,373	1,760	1,199	31,858	186,151
Cypress[e]	6	803	1,053	1908	.....do	...do	190	30	16	10 10	13 0	1,000	7	23	20,285	2,605	4,069	38,238	191,633
Mangrove	6	593	668	1897	.....do	...do	164	30	12	7 4	8 1	550	6	22	14,170	1,554	4,714	32,988	74,998
Snowdrop	6	30	41	1896	Gasoline, screw	Wood	69	11	5	2 11	3 7	32	2	2	9,281	[e]6,255	943	5,215	9,700
Water Lily	6	29	39	1895	.....do	...do	64	11	5	2 11	3 8	36	2	2	5,674	[e]3,535	312	4,725	9,261
Arbutus	7	398	545	1879	Steamer, screw	...do	153	25	11	7 1	9 0	360	6	19	9,550	1,087	101	29,727	49,769

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Camellia	8	276	377	1911	do	Steel	117	24	10	5	10	7	7	280	4	12	4,999	476	1,271	18,464	57,412
Magnolia	8	736	916	1904	do	do	173	30	13	7	11	9	6	700	5	22	10,872	1,518	4,962	29,142	124,874
Sunflower	8	728	986	1907	do	do	174	31	15	9	8	12	1	900	7	22	12,895	1,863	2,227	35,609	124,958
Myrtle	9	435	542	1872	do	Wood	140	25	11	9	6	11	0	225	4	17	8,177	748	242	24,886	44,500
Crocus	10	f 542	f 836	1904	do	Steel	165	29	14	8	0	10	11	700	6	22	7,884	1,429	6,083	30,635	119,718
Amaranth	11	f 597	f 975	1892	do	do	166	28	14	8	6	12	6	672	5	19	10,341	1,496	4,006	30,539	74,994
Aspen	11	f 353	f 415	1906	do	do	126	25	12	7	3	8	3	440	4	10	7,880	622	2,608	16,238	70,573
Clover	11	f 163	f 205	1899	do	Wood	93	22	7	5	4	6	4	140	4	8	9,896	368	758	13,555	.....
Marigold	11	f 477	f 696	1890	do	Iron	160	27	12	8	7	11	3	550	5	19	11,823	990	671	25,071	84,871
Hyacinth	12	f 493	f 914	1903	do	Steel	165	28	14	7	0	11	6	878	5	19	10,030	1,388	3,460	26,710	115,000
Sumac	12	f 600	f 887	1903	do	do	169	30	13	8	10	11	9	700	6	22	11,638	1,612	2,748	32,393	114,992
Goldenrod	13, 14	f 194	f 283	1888	Steamer, stern-wheel	do	169	27	4	2	5	3	4	152	3	15	3,328	448	1,319	9,354	33,221
Oleander	15	f 418	f 494	1903	do	do	189	34	7	3	6	4	1	600	3	15	13,549	2,107	4,159	23,300	60,000
Kukui g	16, 19	803	1,053	1908	Steamer, screw	do	190	30	16	10	10	13	0	1,000	7	22	7,547	1,353	11,705	46,331	213,880
Fern h	16	253	717	1915	do	Wood	112	22	10	7	3	8	6	330	4	8	.....	.....	.....	.....	62,100
Heather	17	631	831	1903	do	do	179	28	15	9	6	11	6	685	6	19	8,078	1,152	11,527	31,391	118,568
Manzanita	17	803	1,053	1908	do	do	190	30	16	10	10	13	0	1,000	6	23	13,087	1,909	1,941	39,419	211,817
Madrono	18	654	806	1885	do	Iron	180	27	15	9	9	11	6	750	6	19	10,744	1,385	2,729	42,118	87,872
Sequoia	18	803	1,053	1908	do	Steel	190	30	16	10	10	13	0	1,000	6	23	9,760	1,155	344	36,615	213,499
Columbine g	19, 16	464	643	1892	do	do	155	27	15	10	0	12	3	800	6	19	13,139	1,168	8,300	4,322	93,993

a Light—without cargo and deck loads, and a minimum supply of stores, provisions, water, and coal.
b Loaded—bunkers full of coal, all tanks, including trimming tanks, full of water; full stores and provisions, and an average maximum cargo and deck load.
c Length between perpendiculars.
d Also 9,868 gallons gasoline and 7,757 gallons kerosene.
e Gallons gasoline.
f Displacement (fresh water).
g Equipped with radio.
h Completed and placed in commission June 25, 1915.

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LIGHTHOUSE VESSELS SOLD OR TRANSFERRED DURING THE FISCAL YEAR 1915.

Light vessel *No. 50*, formerly stationed off Columbia River, Oreg. and Wash., was surveyed and condemned as unserviceable and of no further use to the Service, and sold on April 27, 1915, to the highest bidder for $1,667.99.

Light vessel *No. 59*, formerly stationed at Poe Reef, Lake Huron, Mich., was surveyed and condemned as unserviceable and of no further use to the Service, and sold on October 1, 1914, to the highest bidder for $340.

CONSTRUCTION OF TENDERS AND LIGHT VESSELS.

Tender "Fern."—Acts of May 27, 1908, and March 4, 1909, appropriated $200,000 for one tender (*Aster*), and the act of July 27, 1912, authorized the use of this amount for the construction of two tenders for general service. Plans and specifications covering a small tender for service in the inside waters of Alaska were issued, and on April 17, 1914, a contract was awarded for its construction to Hall Bros. Marine Railway & Shipbuilding Co., Winslow, Wash., in the sum of $62,000. The vessel was launched February 6, 1915, completed during the fiscal year and proceeded to her station of duty on July 1, 1915. Amount expended to June 30, 1915, $38,989.90.

Tender "Laurel."—Appropriation of March 4, 1907, $60,000, for a tender for the fifteenth district (*Dandelion*); authority of act of July 27, 1912, to use this appropriation for a tender for general service. Plans were prepared for a small tender for work in the inside waters of the Atlantic coast, and on September 9, 1913, a contract was awarded for its construction to Spedden Ship Building Co., Baltimore, Md., in the sum of $41,000. The vessel was completed during the fiscal year and went into commission on May 21, 1915. Amount expended to June 30, 1915, $45,711.13.

Tender "Palmetto."—Acts of May 27, 1908, and March 4 1909, appropriated $200,000 for one tender (*Aster*) and the acts of July 27, 1912, and March 3, 1915, authorized the use of this amount for the construction of two or more tenders for general service. Plans were prepared for a light-draft tender for use in the inside waters of the sixth district, and on September 3, 1915, a contract was awarded to the Merrill-Stevens Co., Jacksonville, Fla., in the sum of $28,975. No expenditures were made to June 30, 1915. The appropriation of $30,000, made by the act of May 27, 1908, for a tender for the engineer sixth lighthouse district or elsewhere will probably be used for the purchase of a small tender for use in the third district. Expenditures for plans under this appropriation to June 30, 1915, amounted to $2,921.40.

Tender "Pansy."—The act of March 4, 1909, appropriated $12,000 for repairs to the lighthouse tender *Pansy*. A new boiler and extensive repairs were completed during the fiscal year. Amount expended to June 30, 1915, $10,868.62.

Tender "Rose."—Acts of May 27, 1908, and March 4, 1909, appropriated $200,000 for one tender (*Aster*), and the act of July 27, 1912, authorized the use of this amount for the construction of two tenders for general service. As one of these plans and specifications were completed for a tender of moderate size and draft for use in the small harbors and inside waters of the coasts of Oregon and Washington, and on November 6, 1914, a contract was awarded for its construction to Anderson Steamboat Co., Seattle, Wash., in the sum of $87,950. Amount expended to June 30, 1915, $1,027.24.

Tender "Cedar."—The act of January 25, 1915, appropriated $250,000 for a lighthouse tender for general service. Plans and specifications were immediately prepared for a first-class seagoing tender, for service in Alaska, and on May 4, 1915, a contract was awarded for its construction to the Craig Shipbuilding Co., Long Beach, Cal., in the sum of $234,500. Amount expended to June 30, 1915, $652.80.

Light vessel "No. 96."—Appropriation of March 4, 1911, $75,000, for a light vessel for service at or near a point between Point Abino and Sturgeon Point in Lake Erie. Plans and specifications were prepared for a nonpropelling light vessel, and contract was entered into on April 24, 1913, with the Racine-Truscott-Shell Lake Boat Co., Muskegon, Mich., for the construction of this vessel, in the sum of $69,850. The vessel was completed during the fiscal year, and placed in service on April 24, 1915, at the opening of navigation. Amount expended to June 30, 1915, $64,874.23.

Light vessel "No. 98."—Act of August 26, 1912, appropriated $250,000 for light vessels for general service. As one of these, it was decided to build a duplicate of *No. 96*, the design of which was approaching completion, for service on the Lakes. Bids were received and contract was entered into on April 24, 1913, with the Racine-Truscott-Shell Lake Boat Co., Muskegon, Mich., for its construction, in the sum of $69,850. It was subsequently decided to install an internal-combustion kerosene propelling engine; and on August 26, 1914, a contract was awarded to August Mietz, New York, for the purchase of the engine, in the sum of $6,280, and on August 5, 1914,

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a contract was awarded to the Racine-Truscott-Shell Lake Boat Co., Muskegon, Mich., for the installation, in the sum of $5,560. The latter-named company went into the hands of a receiver prior to the completion of all the work, which was finished directly by the Lighthouse Service. On June 12, 1915, the vessel was placed in service. Amount expended to June 30, 1915, $81,943.85

Light vessel "No. 99."—Act of August 26, 1912, appropriated $250,000 for light vessels for general service. It is proposed to build a vessel with the available balance of the appropriation. A preliminary design has been prepared. Amount expended to June 30, 1915, $5,144.61.

Light vessel "No. 100."—The act of August 24, 1912, appropriated $130,000 for a light vessel for general service. It is proposed to build a large vessel that will be suitable for important exposed stations. No expenditures to June 30, 1915.

Light vessel "No. 101."—Act of August 26, 1912, appropriated $250,000 for light vessels for general service. Plans and specifications were prepared for a second-class vessel for general relief duty on the Atlantic coast, and on March 6, 1915, a contract was awarded for its construction to the Pusey & Jones Co., of Wilmington, Del., in the sum of $93,699. Amount expended to June 30, 1915, $459.

Light vessel "No. 102." (Southwest Pass).—The act of October 22, 1913, appropriated $125,000 for a light vessel for the Southwest Pass entrance to the Mississippi River, La. Plans and specifications for a vessel generally similar to *No. 101* were prepared, and on March 6, 1915, a contract was awarded for its construction to The Pusey & Jones Co., of Wilmington, Del., in the sum of $93,699. Amount expended to June 30, 1915, $1,635.59.

SPECIAL WORKS OF CONSTRUCTION COMPLETED (OMITTING VESSELS).

Oil houses for light stations.—The acts of May 27, 1908, March 4, 1909, and June 25, 1910, each appropriated $10,000 for establishing isolated oil houses for the storage of kerosene, etc. During the fiscal year oil houses were completed at the following-named stations:

	Amount expended.		Amount expended.
New Haven, Conn	$307.02	Stratford Shoal, N. Y	$257.72
Southwest Ledge, Conn	438.54	Point Jiguero, P. R	292.14
Saugerties, N. Y	230.48	Honolulu Harbor, T. H	549.97
Whale Rock, R. I	164.18		

THIRD DISTRICT.

Staten Island lighthouse depot, N. Y.—The act of March 4, 1911, appropriated $40,000 for repair and extension of wharves at the general lighthouse depot, Staten Island, N. Y. The extending of the north wharf was completed on June 5, 1913, and repairs to the south wharf was completed in June, 1915. Amount expended to June 30, 1915, $39,976.74. (Description of work accomplished printed in annual report for 1914.)

FOURTH DISTRICT.

Brandywine Shoal, Del.—The act of March 4, 1911, appropriated $75,000 for rebuilding and improving the present light and fog signal at Brandywine Shoal, Delaware Bay, Del., on the present or an adjacent site. The foundation of the lighthouse was launched at Lewes, Del., on July 10, 1913, and was towed to the site and placed on the pile foundation on August 6, 1913. The superstructure was completed on October 8, 1914. The project was completed on November 1, 1914, at a cost of $74,960.34. (See p. 651.)

Miah Maull Shoal, N. J.—Appropriations were made by the acts of June 30, 1906 ($40,000), March 4, 1907 ($35,000), and March 4, 1911 ($30,000), for a light and fog signal station at Miah Maull Shoal, Delaware River. The foundation shell was erected at the site and partly filled with concrete in December, 1909. The superstructure was completed on February 20, 1913, and the permanent fog signal was established on December 5, 1913. The project was completed on June 15, 1915, at a cost of $104,102.48. (Described in annual report for 1913.)

FIFTH DISTRICT.

Thimble Shoal, Va.—The act of June 25, 1910, appropriated $68,000, and the act of August 26, 1912, $39,000 for the establishment of the light and fog signal station at this point. The light and fog signal were put in operation on December 1, 1914. Amount expended to June 30, 1915, $99,952.76. (See p. 653.)

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SIXTH DISTRICT.

Cape Fear River, N. C.—The act of March 4, 1911, appropriated $21,000 and the act of August 26, 1912, appropriated $30,000 for lights and signals in Cape Fear River below Wilmington, N. C. Thirty four-pile reinforced concrete substructures on marine sites with pipe towers and two pipe towers on concrete piers on land have been constructed. Bald Head Light has also been changed from oil burning to acetylene equipment and an auxiliary lens lantern placed in one of the marine structures as an additional aid. The light went into operation on November 11, 1913. Spare equipment was purchased and the work completed May 24, 1915. Amount expended to June 30, 1915, $50,873.27. (Described in annual report for 1913.)

NINTH DISTRICT.

San Juan, P. R., lighthouse depot.—The act of May, 1908, appropriated $15,000 for a storehouse and dock at San Juan, P. R., and the act of July 27, 1912, authorized the use of the unexpended balance of this appropriation for the alteration, repair, and construction of necessary buildings, docks, and improvements of the grounds of the San Juan lighthouse depot. During the fiscal year the alterations and repairs were continued and the work is completed so far as the appropriation allowed.

Amount expended to June 30, 1915, $14,999.40.

SIXTEENTH DISTRICT.

Lincoln Rock fog-signal station.—The act of March 4, 1911, appropriated $25,000 for rebuilding and improving the light and fog signal at Lincoln Rock, Alaska. The new station was placed in commission October 10, 1912; it was entirely completed during the past fiscal year. Total expended to June 30, 1915, $24,774.49.

SEVENTEENTH DISTRICT.

Warrior Rock, Oreg.—The act of October 22, 1913, appropriated $2,000 for improving Warrior Rock Light Station, Oreg., including the purchase of additional land. One and one-eighth acres, more or less, were purchased, including the dwelling and other buildings thereon, at a total cost of $2,000.

EIGHTEENTH DISTRICT.

Point Arena Light Station, Cal.—The act of October 22, 1913, appropriated $3,000 for the completion of the unfinished portion of the Government road from Rollerville to the Point Arena Lighthouse. The work was completed August 1, 1914. The amount expended to June 30, 1915, was $3,000.

NINETEENTH DISTRICT.

Kilauea Point, Kauai Island, Hawaii.—The act of May 27, 1908, appropriated $75,000 for a light and fog-signal station at some point on the northerly or westerly coast of Kauai Island, Hawaii. On May 1, 1913, the light went into operation and on June 30, 1913, work was suspended owing to exhaustion of funds. By act of August 1, 1914, $3,000 was appropriated for the completion of this station and accordingly work was resumed on November 27, 1914, and the station completed February 2, 1915. Total cost to June 30, 1915, $77,982.07.

Light keeper's dwelling, Barbers Point Light Station, Hawaii.—With an allotment of $3,200 from the appropriation for light keepers' dwellings provided by act of May 27, 1908, a one-story single-frame structure with plastered interior and complete modern plumbing and water systems was erected June 26, 1915, for the keeper at Barbers Point, Hawaii. Total cost to June 30, 1915, $3,198.96. (See p. 652.)

SPECIAL WORKS OF CONSTRUCTION UNCOMPLETED (OMITTING VESSELS).

SECOND DISTRICT.

Cape Cod Canal Lights, Mass.—Appropriation of $50,000 was made by the act of August 1, 1914. Twelve acetylene-lighted pile dolphins, in Buzzards Bay, and an electric light on iron tower, in temporary location on breakwater at Sandwich, Cape Cod Bay, were established. Upon completion of breakwater, tower will be moved to

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permanent location on end of same, and electrically operated fog bell will be operated from same, as well as light. One gas-lighted buoy on Cleveland Ledge, Buzzards Bay, was established. Gas buoy on Negro Ledge, and three gas and one gas and bell buoy at entrance to dredged channel, Buzzards Bay approach, will be established, and light and fog signal at Wings Neck will be improved during fiscal year 1916. Probable date of completion will depend upon delivery of apparatus and completion of breakwater. Amount expended to June 30, 1915, $41,658.85.

THIRD DISTRICT.

Staten Island, N. Y., and West Bank, N. J.—The acts of June 30, 1906, and March 4, 1909, each appropriated $50,000 for a lighthouse on Staten Island, N. Y., and the raising of West Bank Light, N. J. This act of June 30, 1906, also appropriated $10,000 for a temporary structure to maintain West Bank Light while being raised, and a temporary structure for North Hook Light while being moved. All work except installing lightning rod at Staten Island Light has been completed, and the new light was put into operation on April 15, 1912. It is expected that all work will be completed about July 30, 1915. Amount expended to June 30, 1915, $73,926.03.

Stonington, Conn.—The act of March 4, 1911, appropriated $500 for the repair of the sea wall at Stonington Point, Conn. It is expected that the work will be completed about November 15, 1915. Amount expended to June 30, 1915, $7.73.

Staten Island lighthouse depot, N. Y.—The act of March 4, 1911, appropriated $30,000 for constructing a power house and foundry, and for completing the equipment, wiring, etc., of the power plant at the general lighthouse depot, Staten Island, N. Y. The power house, foundry building, and the installation of the machinery were all completed with the exception of part of the floors in the power house and the installation of the machinery in the foundry. It is expected that all work will be completed about November 1, 1915. Amount expended to June 30, 1915, $29,455.29. The act of August 1, 1914, appropriated $23,000 for the erection of a new carpenter shop at the general lighthouse depot, Staten Island, N. Y. The plans and specifications for this building have been prepared and proposals invited. It is expected to have all work completed about June 1, 1916. No expenditures have been made from this appropriation.

Point Judith Breakwater, R. I.—The act of March 4, 1909, appropriated $12,000 for establishing lights and fog signals on the breakwater of the Harbor of Refuge, Point Judith, R. I. Four lights were completed and went into commission on October 22, 1912. The erection of one more light is in progress, and it is expected will be completed about July 10, 1915. The structures consist of hollow cast-iron columns with a tank house around the top for holding the acetylene gas tanks. The total cost to June 30, 1915, was $11,387.36.

Rondout Creek, Hudson River, N. Y.—The act of March 4, 1911, appropriated $40,000 for establishing a light and fog signal station at or near the mouth of Rondout Creek, Hudson River, N. Y. The work was started in March, 1914, and it is expected will be completed about September 15, 1915. Amount expended to June 30, 1915, $21,590.75.

Hunts Point, N. Y.—The act of March 4, 1911, appropriated $5,000 for the establishment of a light and fog signal to mark Hunts Point, between Hell Gate and Whitestone Point, East River, N. Y. Steps have been taken for procuring a site for this light station from the State of New York. The matter is held in abeyance pending the determination of the extent of development of bulkheads and docks to be built at this point. The date of completion is indefinite. No expenditure has been made from this appropriation.

FOURTH DISTRICT.

Joe Flogger Shoal, Del.—The act of June 20, 1906, authorized $75,000 for establishing a light and fog signal at or near this shoal. The act of June 30, 1906, appropriated $40,000 for this purpose, and the act of June 17, 1910, increased the limit of cost for this light and fog signal to $105,000. An additional appropriation has not yet been made. Work on this project has been deferred, as the total amount necessary has not been appropriated and other projects are considered of greater importance. The shoal is now marked by a gas buoy. Amount expended to June 30, 1915, $603.21.

FIFTH DISTRICT.

Norfolk Harbor, Va.—The act of March 4, 1911, appropriated $35,000 for establishing an adequate system of lighting in the channel leading to Norfolk Harbor, Va. Work under the appropriation is still in progress. During the year orders have been placed to purchase six acetylene buoys for use at some of the more important points. Amount expended to June 30, 1915, $31,393.66.

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Fort McHenry Channel, Md.—The act of March 4, 1911, appropriated $125,000 for range lights in the Fort McHenry Channel, Md. Authority was given by Congress on July 27, 1912, for the use of this appropriation for the establishment of gas buoys and other aids to navigation in the channels leading to Baltimore, Md. During the year four gas buoys, 24 tall-type iron buoys and 1 bell buoy were established. Thirteen additional acetylene gas buoys have been ordered for use in this channel and 4 spare buoys. It is expected the additional buoys will be placed before January 1, 1916. Amount expended to June 30, 1915, $123,025.82.

Chesapeake Bay Entrance, Va.—The act of May 27, 1908, appropriated $27,000 for one buoy to be placed off Cape Henry, one buoy to be placed to the northward of the Middle Ground near the entrance to Chesapeake Bay, and one relief buoy. During the year a submarine bell, operated by the action of the sea, has been installed on the buoy placed off Cape Henry, Va., and the relief buoy similarly equipped. Amount expended to June 30, 1915, $26,836.27.

SIXTH DISTRICT.

Depot for the sixth lighthouse district.—The act of October 23, 1914, appropriated $125,000 for the purchase of a site and the construction of a wharf and buildings for a depot, sixth lighthouse district. The site has been selected, surveyed, and transfer of deed completed, and the site purchased. Specifications for a creosoted timber wharf have been completed and proposals for construction invited. Plans and specifications for a timber bulkhead have been approved and those for arrangement of storehouse are under way. Amount expended to June 30, 1915, $60,774.48.

EIGHTH DISTRICT.

Atchafalaya Entrance Channel, La.—The act of October 22, 1913, appropriated $50,000 for erecting aids to navigation on the Atchafalaya Entrance Channel, La. By letter of November 30, 1914, the War Department advised the Department of Commerce that a portion of the land along the Point Au Fer Reef had been transferred for lighthouse purposes (for the site of the Point Au Fer Reef Lighthouse). Plans and specifications were prepared for the construction of a lighthouse, with fourth-order light and bell fog signal, on 25 iron-cased piles; a carbide house, boathouse, boatways, wharf and walks on Point Au Fer Reef, two lighted beacons each on nine iron-cased piles along the channel in the Gulf outside of the reef, and three lighted beacons each on four iron-cased piles along the channel in Atchafalaya Bay. Amount expended to June 30, 1915, $2,685.

Galveston Jetty Light Station, Tex.—The act of June 11, 1896, appropriated $35,000, and the act of May 27, 1908, $10,000 for establishing a light and fog signal at or near the outer end of one of the jetties at Galveston Harbor, Tex. During the fiscal year the structural steel for the superstructure was purchased and delivered at Galveston; a construction wharf was erected at the site; the structural steel substructure and superstructure were erected; and the ribbed expanded metal reinforcement and cement for the walls and other materials were purchased and construction commenced. It is expected to complete the structure by December, 1915. Amount expended to June 30, 1915, $36,203.39.

Sabine Pass Jetty, Tex.—The act of May 27, 1908, appropriated $40,000 for a light and fog signal at or near the end of Sabine Pass Jetty. Nothing has been done on the work, in view of the proposed project of the War Department to extend the jetties to the 25-foot contour, a distance of possibly 2 miles. At the close of the fiscal year 1915 no money had been expended or obligated.

NINTH DISTRICT.

Navassa Island Light Station, West Indies.—The act of October 22, 1913, appropriated $125,000 for the erection of a light station on this island. Surveys were made in preceding fiscal year, and plans, specifications, contract forms, etc., were prepared and the work advertised. Bids will be opened in September, 1915, and it is expected that about two years will be required for completion. No expenditures to June 30, 1915.

TENTH DISTRICT.

Ashtabula Harbor, Ohio.—The act of October 22, 1913, appropriated $45,000 for rearranging, rebuilding, and improvement of aids to navigation at Ashtabula Harbor, Ohio. Detailed plans were completed. Acetylene flashing lights were established on east and west pierheads July 17, 1914. On June 30, 1915, the forms for building up

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the concrete base had been completed and deposition of concrete begun. Metal work for addition to fog-signal house is being constructed under contract. Diaphone fog-signal apparatus has been ordered. It is expected to complete the project during the present season. Amount expended to June 30, 1915, $8,987.29.

Cleveland Harbor, Ohio.—The act of October 22, 1913, appropriated $17,600 for the removal, reconstruction, and improvement of the fog-signal station at Cleveland, Ohio. Metal work for the building is being constructed under formal contract and was practically completed at the shops on June 30, 1915. The work at the site will be commenced in the near future. It is planned to complete the structure during the present season. Diaphone fog-signal apparatus has been ordered. Amount expended to June 30, 1915, $221.42.

Lorain Harbor, Ohio.—The act of October 22, 1913, appropriated $35,000 for a light and fog signal station and improvement of aids to navigation at Lorain Harbor, Ohio. A fourth-order lens and diaphone fog-signal apparatus have been ordered. Preparation of detailed plans are well advanced. It is expected to begin operations at the site early in the spring of 1916. Amount expended to June 30, 1915, $3,473.97.

ELEVENTH DISTRICT.

Detroit River, Michigan.—The act of March 4, 1911, appropriated $210,000 for establishing aids to navigation along the Livingstone Channel, Detroit River, Mich., including authority to locate and construct lights and to place buoys necessary to properly mark this channel. On June 30, 1915, 12 concrete piers had been completed, and 8 placed in commission. The other 4 await the completion of contemplated changes in the channel before they can be utilized. Fourteen gas buoys and 20 spar buoys are now used to mark the channel in addition to the lights on piers. Two of the above piers were constructed and the lights placed in operation within the year. Plans have been prepared for the construction of a light and fog signal at the south end of the channel. Two additional pier lights will be established, taking the place of two gas buoys now maintained, so soon as the proposed widening of the channel shall have been completed. Total expenditure to June 30, 1915, $143,127.38.

Ashland, Wis.—The act of October 22, 1913, appropriated $25,000 for the construction of aids to navigation at Ashland, Wis. The project as approved, and now being carried out, consists in an electrically operated light and fog signal on the outer end of the breakwater, supplied with power through a submarine cable to shore connected with the city power lines. The construction of a reinforced concrete tower on the breakwater, for housing the light and signal, is now nearing completion and the submarine cable has been laid. A dwelling and boathouse for one keeper will be constructed on shore sites purchased for the purpose. The operation of both signal and light will be controlled from a shore control station near the dwelling. It is expected that the work will be completed about October 15, 1915, and the station then placed into operation. Amount expended to June 30, 1915, $19,093.32.

Superior Entry, Wis.—The act of June 30, 1906, appropriated $20,000 for range lights at Superior Pierhead, Lake Superior, Wis. The act of March 4, 1911, appropriated $25,000 additional for the completion of lighting of breakwaters and piers at Superior Entry, Wis. Lights on the outer north breakwater and inner north pierhead were completed and established on October 10, 1912. The main light and fog signal station was completed and placed into commission on June 30, 1913. The inner south pierhead light was completed on October 10, 1912, and went into commission on June 12, 1914, when the remains of the old breakwater outside it had been dredged away. An additional light at the inner end of the south canal pier and known as Superior Harbor Basin Light No. 1 was established on June 30. An additional dwelling for this station, made necessary by the additional assistant authorized, is now under construction and will soon be completed. Total cost of work to date, $37,816.14

TWELFTH DISTRICT.

Manistique, Mich.—The act of October 22, 1913, appropriated $20,000 for aids to navigation, Manistique, Mich. The lot for keepers dwelling has been surveyed, purchased, and title vested in the United States. Materials have all been purchased for the keepers dwelling and construction is in progress. The concrete foundation for Manistique Light Station has been completed and bids have been accepted for construction of a steel tower, in which an electric light will be exhibited in a fourth-order lantern. The installation of a fixed white post lantern on Manistique West Pierhead was completed October 30, 1914. The installation of a 25-foot steel tower and flashing acetylene equipment on Manistique West Breakwater was completed October 30, 1914. Amount expended under this appropriation to June 30, 1915, $12,261,58.

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Oconto, Wis.—The act of October 22, 1913, appropriated $5,000 for pierhead lights, etc., Oconto Harbor, Wis. The installation of a 25-foot steel tower and flashing acetylene equipment for Oconto Harbor South Pierhead Light was completed April 12, 1915. A gas and bell buoy for Oconto Harbor Channel has been ordered and early delivery is expected. Amount expended under this appropriation to June 30, 1915, $2,105.

White Shoal, Mich.—The act of March 4, 1907, appropriated $250,000 for a light and fog signal station at White Shoal, north end of Lake Michigan, to replace the White Shoal Light Vessel, which was then located over these dangerous shoals. The light was placed in commission on Sptember 1, 1910, and the fog signal on September 15, 1910. A submarine bell was established September 20, 1911. A water-supply system was installed in October, 1911. An oil-storage system was installed during June, 1913. An auxiliary flashing acetylene winter light was installed during December, 1914, to serve as an aid to mariners between time station is closed and actual close of navigation. The equipment of the three boat cranes with air drive is still under consideration and will be purchased during present season. Amount expended under this appropriation to June 30, 1915, $225,035.07.

SIXTEENTH DISTRICT.

Cape St. Elias Light and Fog-Signal Station.—The act of October 22, 1913, appropriated $115,000 for a light and fog signal to be established at or near Cape St. Elias, Alaska. The lens, pedestal, and clock for this light have been ordered. The metal superstructure of the tower, including the watch room and gallery, and the helical bar second-order lantern has been completed and shipped to San Francisco for expositon purposes as have the two air compressors for the fog signal together with air sirens, trumpets, air tanks, and piping for the same. Fuel-oil storage tanks have been completed and delivered. The site has been selected on Cape St. Elias and up to June 30, 1915, the following work had been accomplished at the site: Plan for tower and fog signal prepared and approved, surveys completed and plotted, construction camp established and the camp and storage buildings, shops, etc., completed, temporary and permanent tramways completed, concrete plant, bins, etc., completed ready for actual construction, excavation 50 per cent complete, screening and delivery of sand and gravel 50 per cent complete, delivery of materials to the site 30 per cent complete. It is expected that the light will be in operation about the beginning of the next fiscal year and the fog signal in the fall of 1916. The amount expended to June 30, 1915, is $22,142.48.

Aids to navigation, Alaska.—The acts of March 4, 1911, and August 1, 1914, each appropriated $60,000 for establishing aids to navigation in Alaskan waters. During the year 1 acetylene light was established, 1 oil light changed to acetylene, structures for 11 lights were erected ready for illuminating apparatus, and material is on hand or in transit for 19 others, nearly all of which it is expected will be in commission by the fall of 1915. The appropriation of 1911 has been expended and to June 30, 1915, the total expenditure from the appropriation of August 1, 1914 was $43,073.98.

SEVENTEENTH DISTRICT.

Aids to navigation, Puget Sound, Wash.—The act of October 22, 1913, appropriated $30,000 for aids to navigation and improvements of existing aids in Puget Sound and adjacent waters, Washington. Under this appropriation the following work was performed:

Slip Point Light Station, Wash.: Change of type and characteristic; remodeling of light and fog signal building; and change of fog signal, to cost approximately $12,000. Expended on this project to June 30, 1915, $3,494.00. Probable date of completion November 30, 1915.

Hein Bank Gas and Bell Buoy, Juan de Fuca Strait, Wash., established at a cost of $2,449.

Post Point Gas and Bell Buoy, Bellingham Bay, Washington Sound, Wash., establishing. Expended on this project to June 30, 1915, $2,469. Probable date of completion, August 1, 1915.

Waterman Point Light, Port Orchard, Puget Sound, Wash., establishing a flashing acetylene light. Expended on this project to June 30, 1915, $840. Probable date of completion, October 1, 1915.

Additional aids will be established under this appropriation as rapidly as possible.

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UNEXPENDED BALANCES ON JUNE 30, 1915, FROM APPROPRIATIONS FOR SPECIAL WORKS.

District.	Title of appropriation.	Acts.	Balance.
General..	Tender for first lighthouse district	May 27, 1908; Mar. 4, 1909	$155,295.33
	Tender for fifteenth lighthouse district	Mar. 4, 1907	10,851.69
	Light vessels for general service	Aug. 24, 1912	130,000.00
		Aug. 26, 1912	162,452.54
	Lighthouse tender, general service	Jan. 25, 1915	249,347.20
	Oil houses for light stations	June 25, 1910	2,774.71
	Lightkeepers' dwellings	May 27, 1908	963.59
2d	Cape Cod Canal Lights, Mass	Aug. 1, 1914	26,215.55
3d	Staten Island and West Bank Light Station, N. Y.	June 30, 1906; Mar. 4, 1909	26,073.97
	Newark Bay Beacon Lights, N. J	Mar. 4, 1907; Oct. 22, 1913	5,033.52
	Point Judith Breakwater Lights, R. I	Mar. 4, 1909	612.64
	Repairs to lighthouse tender Pansy	do	1,131.38
	Staten Island lighthouse depot, N. Y	Mar. 4, 1911; Aug. 1, 1914	23,544.71
	Stonington Light Station, Conn	do	492.27
	Rondout Creek Light Station, N. Y	do	18,409.25
	Hunts Point Light Station, N. Y	do	5,000.00
4th	Joe Flogger Shoal Light Station, Delaware River	June 30, 1906	39,396.79
	Miah Maull Shoal Light Station, Delaware River	June 30, 1906; Mar. 4, 1907; Mar. 4, 1911.	897.52
5th	Chesapeake Bay, lighted buoys	May 27, 1908	163.73
	Thimble Shoal Light Station, Va	June 25, 1910; Aug. 26, 1912	7,047.24
	Fort McHenry Channel Range Lights, Md	Mar 4, 1911	35,717.58
	Lighting Norfolk Harbor, Va	do	17,881.84
6th	Tender for engineer, sixth lighthouse district	May 27, 1908	27,078.60
	Depot for sixth lighthouse district	Oct. 22, 1913	64,225.52
8th	Galveston Jetty Light Station, Tex	June 11, 1896; May 27, 1908	9,182.14
	Tender for inspector eighth lighthouse district	Mar. 4, 1907	6,084.36
	Sabine Pass Jetty Light Station, Tex	May 27, 1908	40,000.00
	Southwest Pass Light Vessel, Mississippi River	Oct. 22, 1913	123,364.41
	Aids to navigation, Atchafalaya Entrance Channel, La.	do	47,317.53
9th	San Juan lighthouse depot, P. R	May 27, 1908	.60
	Navassa Island Light Station, W. I	Oct. 22, 1913	125,000.00
10th	Buffalo Breakwater North End Light Station, N. Y.	Mar. 4, 1911	26.04
	Point Abino Light Vessel, Lake Erie	do	10,125.77
	Cleveland Fog-signal Station, Ohio	Oct. 22, 1913	17,378.58
	Aids to navigation, Ashtabula Harbor, Ohio	do	36,012.71
	Aids to navigation, Lorain Harbor, Ohio	do	32,673.62
11th	Superior Pierhead Range Lights, Wis	June 30, 1906	7,224.98
	Detroit River Lights, Mich	Mar. 4, 1911	66,972.62
	Aids to navigation, St. Marys River, Mich	Aug. 26, 1912	109.91
	Aids to navigation, Ashland, Wis	Oct. 22, 1913	5,906.68
12th	Milwaukee Light Vessel, Wis	May 27, 1908	1,552.60
	White Shoal Light Station, Lake Michigan	Mar. 4, 1907	24,820.93
	Oconto Harbor Lights, Wis	Oct. 22, 1913	2,773.53
	Aids to navigation, Manistique, Mich	do	12,579.03
16th	Aids to navigation, Alaska	Mar. 4, 1909; Aug. 1, 1914	38,706.12
	Cape St. Elias Light Station, Alaska	Oct. 22, 1913	102,976.01
17th	Aids to navigation, Puget Sound, Wash	do	17,679.92
19th	Kauai Island Light Station, Hawaii	May 27, 1908; Aug. 1, 1914	31.18

BALANCES OF SPECIAL APPROPRIATIONS CARRIED TO THE SURPLUS FUND ON JUNE 30, 1915.

The following named balances of special appropriations under the Lighthouse Service remaining on the books of the Treasury Department, and relating to works which had been completed and against which no obligations were known to exist were carried to the surplus fund on June 30, 1915.

Storehouses for oil	$10.98
Monhegan Island Light Station, Me	1,822.43
Negro Point Light Station, N. Y	2,649.08
Point Judith Lighted Buoy, R. I	534.31
Tender for Engineer, Third Lighthouse District	272.15
Staten Island Lighthouse Depot, N. Y., (repairs to wharves)	23.26
Brandywine Shoal Light Station, Del	39.66
Cape Fear River Lights, N. C	126.73
Lincoln Rock Light Station, Alaska	225.51
Total carried to surplus fund	5,704.11

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SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1915.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
1st.....	Tender Hibiscus.....	Schooner Harriet C. Whitehead.	Pulled vessel off Ram Island Ledge, Me.
	J. Burke, keeper, Cape Neddick Light Station, Me.	Unknown man.....	Saved man from probable drowning; furnished him with clothing and shelter.
	E. Reed, keeper, Whitehead Light Station, Me.	Motor boat.....	Recovered boat adrift near station.
	J. W. Jellison, keeper, Tennant Harbor Light Station, Me.	Motor boats.....	Towed 2 disabled boats to their moorings.
	Tender Hibiscus.....	Motor boat.....	Towed to port disabled boat with 2 men on board.
	Tender Zizania.....	Launch.....	Rescued launch, with 2 men aboard, caught in ice.
	Tender Hibiscus.....	Schooner C. W. Dexter	Towed into harbor schooner found in dangerous position with rudder and 1 anchor and chain gone.
2d.....	H. C. Towle, keeper, The Graves Light Station, Mass.	Motor dory and motor boat.	Picked up disabled dory with motor boat in tow at East Point, Nahant, and towed to Bass Point; heavy sea.
	E. C. Mott, assistant keeper, Deer Island Light Station, Mass.	The Morning Star; F. McAlpine, owner.	Rescued 2 men from burning motor boat; furnished food, dry clothing, and lodging for the night.
	J. E. Barrus, keeper, and E. H. Hopkins, assistant keeper, Cape Poge Light Station, Mass.	Power yacht Lanagante.	Assisted in working yacht off bar.
	Tender Anemone.....	Four-masted schooner Geo. F. Scannell, of New York.	Towed to channel schooner anchored in dangerous position, with distress signals up.
	Light Vessel No. 73, Mass....	Power boat; Frederic Nickerson, owner.	Rescued disabled boat and owner.
	Tender Anemone.....	Tug Henry Maurer, with tow.	Towed to Hyannis wharf disabled tug anchored with mud scow off Point Gammon.
	G. I. Cameron, first assistant keeper, and E. Mueller, second assistant keeper, The Graves Light Station, Mass.	.....	Furnished food and shelter for night to 2 officers and 6 sailors from ship who were unable to return on account of heavy wind.
	A. A. Howard, keeper, Stage Harbor Light Station, Mass.	.....	Saved horse from sinking in quicksand and water.
	E. C. Hadley, keeper, Bakers Island Light Station, Mass.	Motor boat.....	Furnished food to 2 Italian fishermen; also put engine in working condition.
	Tender Anemone.....	U. S. S. Celtic.....	Attempted to pull stranded steamer from shoals; unsuccessful.
	H. C. Towle, keeper, The Graves Light Station, Mass.	Motor dory.....	Towed to Lynn a disabled boat drifting to sea with fisherman aboard.
	J. B. McCabe, keeper, and E. C. Mott, assistant keeper, Deer Island Light Station, Mass.	.....do.....	Rescued fisherman in disabled boat.
	J. E. Barrus, keeper, and E. H. Hopkins, assistant keeper, Cape Poge Light Station, Mass.	Three-masted schooner Roger Drury.	Assisted schooner, which had struck 2½ miles south of station.
	Light Vessel No. 47, Mass....	Dories from schooner Washakie.	Assisted and supplied food to 6 men adrift in dories from schooner.
	Light Vessel No. 73, Mass....	Dory from schooner Washakie.	Assisted and supplied food to 2 men adrift in dory from schooner.
3d.....	Ram Island Reef Light Vessel No. 23, Conn.	Power boat; D. Chartier, owner.	Went to assistance and towed disabled boat to safety.
	A. Daunt, master, Bartlett Reef Light Vessel No. 13, Conn., and C. J. Murray, boatbuilder, general depot.	Barney Marsden.....	Rescued helpless man who had fallen off dock.
	W. F. Hill, keeper, Isle La Motte Light Station, Vt.	Motor boat.....	Towed ashore disabled boat, containing 3 persons.
	E. M. Usinger, keeper, Stratford Shoal Light Station, N. Y.	.....do.....	Rescued disabled boat; brought 3 men and 2 women to station; took care of occupants overnight.
	J. Smith, keeper, Duck Island Light, Conn.	Schooner Nettleton; Capt. Lamborn, owner.	Assisted in floating vessel ashore on Duck Island and taking boat to Saybrook.
	J. C. Bouley, keeper, Gull Rocks Light Station, R. I.	Boat from U. S. training station.	Took to place of safety, after 2 hours' work, boat drifting to sea loaded with sand and containing an exhausted man.

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SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1915—Continued.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
3d.....	A. G. Baldwin, keeper, Bridgeport Harbor Light Station, Conn.	C. A. Strat.....	Rescued from drowning in Long Island Sound.
	J. Petterson, keeper, Southwest Ledge Light Station, Conn., and G. Lepol, laborer, general depot.	Power boat.....	Towed disabled boat and 3 men to safety; rough sea and strong wind.
	W. J. Murray, keeper, Little Gull Island Light Station, N. Y.	Schooner Andrew Nebinger.	Assisted schooner stranded on reef; helped to place anchors.
	W. F. Petzolt, assistant keeper, Stratford Point Light Station, Conn.	Motor boat Hale.....	Took to safety disabled boat containing 2 boys.
	G. Ehrhardt, keeper, and J. Hamilton, assistant keeper, Long Beach Bar Light Station, N. Y.	Motor boat Kitty.....	Picked up abandoned boat; turned it over to civil authorities.
	J. B. Murdock, keeper, Rondout Light Station, N. Y.	Exhausted swimmer..	Assisted exhausted swimmer carried out of his course.
	L. P. Brown, keeper, Cold Spring Harbor Light Station, N. Y.	Open launch.....	Rescued and took ashore disabled launch and 4 occupants.
	Do.....	Canoe.....	Rescued 2 young men from filled canoe during heavy storm, and gave them supper, bed, and breakfast.
	W. L. Tutty, keeper, and A. Herne, assistant keeper, New Haven Light Station, Conn.	Motor boat; A. P. Ives and J. H. Burton, owners.	Rescued disabled motor boat and took care of occupants overnight.
	Tender Tulip.....	Tug Thomas O'Brien.	Assisted and towed disabled tug to Gravesend Bay.
	E. E. Gildersleeve, keeper, Saybrook (Lynde Point) Light Station, Conn.	Power boat.....	Assisted ashore 2 occupants of boats caught in ice; cared for them over night and assisted in repairing boat.
	T. J. Murray, keeper, Esopus Meadows Light Station, N. Y.	Ice boat.....	Assisted ashore 2 men and 1 woman whose boat had broken through ice; supplied their needs at station.
	E. E. Gildersleeve, keeper, Saybrook (Lynde Point) Light Station, Conn.	Disabled boat, Capt. J. Mulhaley.	Saved and brought ashore boat, with broken rudder, caught in ice; took care of occupants.
	Cornfield Point Light Vessel No. 48, Conn.	Power boat.....	Towed disabled boat, with 2 occupants, to light vessel; repaired engine.
	W. F. Rhodes, keeper, and V. H. Stanton, assistant keeper, Romer Shoal Light Station, N. Y.	Canoe.....	Rescued 2 men and canoe caught in storm off Romer Shoal and capsized.
	W. H. H. Lake, jr., keeper, Shinnecock Bay Light Station, N. Y.	Boat.....	Assisted boat, with woman occupant, off of shoal.
	L. P. Brown, keeper, Cold Spring Harbor Light Station, N. Y.	Open dory with sail; W. Hill, owner.	Went to assistance of 5 men in disabled boat, supplied oars and towed boat to Oyster Bay.
	J. J. Barnes, keeper, North Dumpling Light Station, N. Y.	Power boat.....	Pulled ashore boat and 2 occupants stranded ashore in strong wind before much damage done.
	J. A. Murdock, keeper, Rondout Light Station, N. Y.	Motor boat Natalie, J. H. Flannery, N. Y.	Assisted in raising sunken boat.
4th.....	W. Spear, keeper, Deep Water Point Range Front Light Station, N. J.	Drowned boy.....	Recovered body of boy drowned near station.
	H. C. Wingate, keeper, Delaware Breakwater Range Front Light Station, Del.	Drowning man.....	Rescued from probable drowning man fallen overboard from passing steamer.
	C. J. Murphy, engineer of Tender Iris.	.....do.....	Saved man from drowning.
	H. C. Wingate, keeper, and H. P. Marshall, first assistant keeper, Delaware Breakwater Range Front Light Station, Del.	Motor boat.....	Rescued 4 men drifting out to sea in disabled boat.
	G. A. Holston, laborer in charge, Lewes Lighthouse Depot, Del.	.....	Made 28-mile trip to sea to bring ashore fireman of Fenwick Island Shoal Light Vessel.
5th.....	C. E. Respess, keeper, E. Davis, assistant keeper, Windmill Point Light Station, Va.	Gasoline launch.....	Assisted occupants of disabled launch.

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SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1915—Continued.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
5th.....	W. L. Rebbel, clerk, office of lighthouse inspector, fifth district.	J. W. Walsh, clerk, fifth inspector's office.	Attempted rescue of Clerk Walsh from drowning.
	M. Hudgins, keeper, and J. M. Ellis, first assistant keeper, Smith Point Light Station, Va.	Motor boat.....	Assisted 2 men when motor had become disabled.
	R. H. Bertram, master, Relief Light Vessel No. 2.	Power yacht Phalarope.	Assisted leaking yacht.
	J. T. Twiford, assistant keeper, Long Shoal Light Station, N. C.	Power boat Robena, Capt. S. Spencer.	Assisted disabled boat.
	T. H. Baum, keeper, Long Shoal Light Station, N. C.	Small sloop.....	Assisted occupants when sloop went aground.
	A. J. English, keeper, Harbor Island Bar Light Station, N. C.	Power boat Viola.....	Assisted disabled United States mail boat.
	L. H. Staubly, keeper, Blakistone Island Light Station, Md.	Sloop Volunteer.....	Assisted sloop in leaking and sinking condition.
	G. M. Willis, sr., keeper, Point No Point Light Station, Md.	W. Yeatman and child	Rescued assistant keeper and child from drowning.
	U. B. Jennett, second officer, tender Jessamine.	Gasoline freighter Margaret Atkinson of Baltimore, Md.	Towed loaded, disabled freighter into Annapolis.
	C. B. Gray, keeper, Greenbury, Point Shoal Light Station, Md.	Canoe.....	Assisted 2 oystermen in capsized canoe.
	W. F. Outten, first officer, tender Woodbine.	.....do.....	Rescued 2 men from drifting canoe.
	J. Hanson, master, Relief Light Vessel No. 72.	S. S. Washingtonian..	Rescued 39 men from steamship rammed off Fenwick Island, Del.
	T. H. Baum, keeper, and J. T. Twiford, assistant keeper, Long Shoal Light Station, N. C.	Schooner Hamlet of Hatteras, N. C.	Assisted schooner run aground on Long Shoal, N. C.
	B. Wroldsen, quartermaster, tender Jessamine.	C. Gregory and C. Sawyer.	Rescued men from drowning after boat capsized in heavy squall.
	A. J. Davidson, first officer, and J. Whitehurst, second assistant engineer, Woodbine.	Tender Woodbine.....	Rendered prompt assistance in saving tender from fire.
	J. R. Monteiro, master, tender Ivy.	Schooners Mary S. Ewing, and Julia and Anne.	Attempted to rescue schooner Mary S. Ewing in a gale; assisted schooner Julia and Anne.
	A. M. Thistel, master, Cape Charles Light Vessel No. 49.	Light Vessel No. 49....	Kept vessel on station, submarine signal and whistle in operation during heavy storm of Apr. 3, 1915.
	F. J. Pusey, mate, in charge of Light Vessel No. 97.	Motor boat.....	Assisted 4 occupants of disabled motor boat.
	E. Meekins, jr., keeper, and W. H. Etheridge, second assistant keeper, Bodie Island Light Station, N. C.	Mail launch Swastika.	Assisted disabled launch with 7 passengers aboard.
	E. L. Thomas, keeper, Tangier Sound Light Station, Va.	Motor boat Bernice L.	Rescued 3 men from boat sunk off station.
	W. R. Schoenfelder, keeper, Fishing Battery Light Station, Md.	Man overboard.....	Assisted man who fell overboard from dredge near station.
	A. J. English, keeper, and C. R. Austin, assistant keeper, Harbor Island Bar Light Station, N. C.	Schooner Davis, Davis, N. C.	Assisted schooner grounded on Harbor Island Bar, N. C.
	W. F. Outten, master, tender Laurel.	Schooner Alert, Seaford, Del., Capt. Winfield Scott.	Assisted schooner flying distress signals; towed her into Annapolis.
6th.....	Tender Mangrove, Master E. C. Tull commanding.	Schooner Wm. H. Yerkes; Dunn Elliot Co., owners.	Brought ashore master and 10 of crew of wrecked schooner.
	Do.....	U. S. Engineers dredge Savannah.	Pulled dredge off shoals, St. Simon Sound, Ga.
	J. Robertson, keeper, and M. B. Wilder, assistant keeper, Little Cumberland Island Light Station, Ga.	Parties searching bodies of crew of Rambler, wrecked near station.	Gave shelter and otherwise assisted searching parties.
	J. Lindquist, keeper, and W. Lindquist, assistant keeper, Mosquito Inlet Light Station, Fla.	Yacht Niagara of New York; J. S. Simmons, owner.	Took owner and family off yacht ashore in breakers; worked off yacht and took it to station.

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SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1915—Continued.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
6th.....	H. S. Svendsen, keeper, South Channel Range, etc., Light Station, S. C.	Launch; name and owner unknown.	Saved launch ashore on breakwater at Sullivans Island, S. C.
	L. H. Bringloe, keeper, G. N. Jackson, first assistant keeper, and A. E. Burn, second assistant keeper, Charleston Light Station, S. C.	Launch.....	Assisted to station and took care of 4 fishermen; repaired launch.
	Do.....	Various small boats...	Furnished food and clothing to 30 fishermen washed ashore on Morris Island, S. C.
	C. P. Honeywell, keeper, J. B. Butler, first assistant keeper, and O. F. Quarterman, second assistant keeper, Cape Canaveral Light Station, Fla.	Steamer Loando; owner unknown.	Assisted ashore officers and crew of wrecked steamer; cared for 3 of crew at station.
7th.....	T. M. Kelly, keeper, J. P. Roberts, jr., first assistant keeper, and T. L. Kelly, second assistant keeper, Rebecca Shoal Light Station, Fla.	Steamers Nordvahlen and Veenbergen.	Assisted steamers ashore near station.
	C. H. Gardner, keeper, Cedar Keys Light Station and Turning Point Light, Fla.	Row boat.....	Rescued from drifting boat man apparently insane.
	H. P. Weatherford, keeper, and R. Palmer, second assistant keeper, Fowey Rocks Light Station.	Yacht May Belle.....	Rescued 5 passengers from yacht which sank immediately after rescue.
	Tender Arbutus.....	American steamer Standard.	Helped disabled steamer to raise anchor.
	C. G. Johnson, keeper, and H. A. Pierce, first assistant keeper, Sand Key Light Station, Fla.	Launch.....	Helped off rocks launch with 4 men aboard.
8th.....	Tender Camellia.....	Racing sloop Stranger; owner unknown.	Righted and towed to port boat capsized during squall.
	Mrs. M. R. Norvell, keeper, Port Ponchartrain Light Station, La.	Man on steamer Hanover.	Brought to station man taken suddenly ill, and cared for him until death.
	Tender Sunflower.....	Schooner Maud B. Krumm; owner unknown	Furnished provisions.
	G. R. Smith, keeper, and L. R. Smith, assistant keeper, Red Fish Bar Cut Light Station, Tex.	Launch.....	Assisted disabled launch; cared for the 4 occupants overnight.
	W. W. Bayly, keeper, Chandeleur Light Station, La.	Schooner Madeline; owner unknown.	Furnished shelter to woman and child taken from schooner which had gone ashore.
9th	Launch of Tender Myrtle....	Ferry launch Dicosha.	Towed to safety wrecked launch with passengers.
	J. M. Agostini, keeper, Catano Range and Anegado Shoal Range Lights.	Launch.....	Assisted disabled launch.
	E. T. O'Mella, former chief clerk.	Canoe.....	Saved man from capsized canoe.
10th	J. C. Belden, keeper, Rock Island Light Station, N. Y.	Large power boat.....	Rescued disabled boat with 5 men on board.
	Do.....	Launch Indunno of Gananoque, Ontario.	Repaired disabled launch towed to station.
	Do.....	Launch.....	Assisted stranded launch into deep water; furnished bed and breakfast for 2 occupants.
	B. A. Dissett, first assistant keeper, Toledo Harbor Light Station, Ohio.	.....do.....	Towed ashore launch with 8 men aboard, disabled and in dangerous position.
	C. Duggan, keeper, S. Bass Island Light Station, Ohio.	Steam barge Isabel Boyce.	Assisted in landing and cared for crew of 8 from burning barge.
	R. C. Graves, keeper, Galloo Island Light Station, N. Y.	Small power boat.	Towed launch 4 miles for supply of gasoline.
	F. Ritter, keeper, Sandusky Bay Inner Range Light Station, Ohio.	Two launches.....	Towed to safety disabled launch with 1 occupant, and motor boat with 4 occupants.
	C. H. Tucker, keeper, Oswego Light Station, N. Y.	Rowboat.....	Brought to station 2 women rescued from drowning.
	H. E. Waits, keeper, Sunken Rock Light Station, N. Y.	Skiff.....	Rescued man in skiff from being run down by steamer.

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SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1915—Continued.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
11th.....	R. Carlson, keeper, Whitefish Point Light Station, Mich.	Steamer Ora Endress..	Rescued 11 men from capsized vessel; provided food and clothing at station.
	W. G. Marshall, keeper, and F. McFall, assistant keeper, Windmill Point Light Station, Mich.	Launch.....	Pulled launch at sea wall out of reach of heavy sea.
	J. Metivier, keeper, and L. Hudak, third assistant keeper, Spectacle Reef Light Station, Mich.	Motor boat Effie.....	Towed disabled launch to shore.
12th.....	E. C. Johnson, assistant keeper, Calumet Pierhead Light Station, Ill.	Sloop Rascal.....	Assisted drifting sloop, with 3 men on board.
	J. M. Robinson, keeper, and H. Osby, first assistant keeper, Calumet Harbor Light Station, Ill.	Motor boat T. Bradwel	Assisted disabled motor boat with 6 men aboard.
	S. M. Danielsen, keeper, Chicago Harbor Light Station, Ill.	Gasoline launch The Bug.	Assisted launch, with 1 man aboard, from drifting out into lake.
	G. Fox, second assistant keeper, Chicago Pierhead Range Light Station, Ill.	Drowning man..	Rescued man who fell from dock near station.
	F. A. Drew, keeper, and G. W. Drew, assistant keeper, Green Island Light Station, Wis.	Gasoline launch Alice W.	Towed disabled launch to safety.
	Do.....	Motor boat.....	Assisted 4 men in leaky boat.
	Do.....	.....do.....	Brought to safety 2 men and 1 woman in disabled boat.
	F. A. Drew, keeper, Green Island Light Station, Wis.	Gasoline launch, Wesley L.	Assisted grounded launch.
	G. H. Sheridan, keeper, Kalamazoo Light Station, Mich.	Open gasoline launch, Quindess; J. D. Annable, owner.	Rescued 3 women and 4 men; brought launch to safety.
	Do.....	Gasoline launch, Lady Ramor; F. Sholtz, owner.	Assisted launch, with 3 women and 3 men aboard, ashore during gale.
	A. C. Erickson, keeper, Little Traverse Light Station, Mich.	Motor boat.....	Towed to safety disabled launch with 2 men aboard.
	Do.....	Gasoline launch, patrol boat No. 4; State of Michigan, owner.	Towed disabled launch into dock.
	J. Napelzinski, keeper, Manitowoc Breakwater Light Station, Wis.	Dredge and scows; Greiling Bros., owners.	Assisted in floating grounded dredge and scows.
	T. Robinson, keeper, Muskegon Pierhead Range Light Station, Mich.	Motor boat, Bohemian Girl.	Assisted disabled motor boat with 2 boys aboard.
	J. M. Marshall, keeper, and J. H. Sullivan, third assistant keeper, White Shoal Light Station, Mich., and W. Barnum, first assistant keeper, Old Mackinac Point Light Station, Mich.	Launch Ida L.....	Saved launch during gale.
	G. M. S. Hansen, keeper, Sheboygan Pierhead Light Station, Wis.	Rowboat.....	Brought ashore 2 men and capsized boat.
	L. Bourisseau, keeper. W. F. Green, first assistant keeper, O. E. Dame, second assistant keeper, and F. L. Moore, third assistant keeper, South Fox Island Light Station, Mich.	Motor boat.....	Brought ashore and repaired disabled sloop; cared for 1 man, 1 woman, 2 children overnight.
	J. Fountain, keeper, and W. Hall, assistant keeper, St. Helena Light Station, Mich.	.....do.....	Assisted 2 men in leaking boat.
	Do.....	.....do.....	Towed disabled launch to safe harbor.
	C. H. Hubbard, master, and crew of tender Sumac.	Steamer Joseph C. Butler.	Assisted steamer carried into shoal water.
	H. R. Bevry, keeper, J. Lonne, first assistant keeper, and W. H. Nash, second assistant keeper, Wind Point Light Station, Wis.	Motor boat, Jeanette N.; K. A. Nelson, owner.	Saved launch in rough sea.

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SAVING OF LIFE AND PROPERTY BY VESSELS OR EMPLOYEES OF THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1915—Continued.

District.	Vessel or employee rendering service.	Vessel, etc., aided.	Nature of assistance.
12th.....	A. Van Velzen, first assistant keeper, Chicago Pierhead Light Station, Ill.	Drowning man.....	Saved from drowning man who fell from pier.
16th.....	E. Pecor, first assistant keeper, and D. O. Kinyon, second assistant keeper, Tree Point Light Station, Alaska.	Launch Cora; C. Nelson, owner.	Furnished oil, gasoline, and provisions to enable boat and occupants to reach Ketchikan.
	N. S. Douglas, keeper, and G. Tibbets, assistant keeper, Lincoln Rock Fog Signal Station, Alaska.	C. Sands, trapper.....	Gave provisions to trapper whose food had become exhausted.
	Do.....	R. S. Mowin, and C. Gorden.	Cared for party, hungry and nearly frozen, who had lost their launch.
	W. J. Pearson, first assistant keeper, W. A. Phillips, second assistant keeper, and W. Rosenberg, substitute keeper, Cape Sarichef Light Station, Alaska.	Coast Guard Service S. S. Manning landing boat.	Cared for late keeper of station during illness; attempted to rescue persons when landing boat capsized.
17th.....	O. H. Wayson, assistant keeper, Smith Island Light Station, Wash.	Motor boat.....	Towed ashore boat with 4 occupants.
	E. A. Brooks, keeper, New Dungeness Light Station, Wash.	Steamer Sioux.....	Assisted steamer and took off passengers.
	Tender Heather, Capt. E. Hammarstrom.	Two fishing boats.....	Convoyed boats to Astoria from Columbia River bar.
	J. M. Coleman, keeper, Tongue Point Lighthouse Depot, Oreg., O. Hoveden, temporary laborer at depot, and G. Pearson, laborer in charge of lights on Columbia River.	Upturned boat.....	Rescued man clinging to upturned boat.
18th.....	Tender Madrono.....	Navy tug Vigilant....	Towed disabled tug off beach at Goat Island.
	Keepers, Pigeon Point Light Station.	Gasoline fishing boat; Union Fish Co., owners.	Hauled boat off rocks and transported it to safety.
	Crew of San Francisco Light Vessel No. 70.	U. S. Navy launch Castro.	Rescued man fallen overboard.

DAMAGE BY COLLISIONS.

The following is a list of the more important collisions affecting the property of the Lighthouse Service which occurred during the fiscal year 1915:

On July 7, 1914, Shovelful Shoal Light Vessel No. 3, Mass., was struck by a barge in tow of the tug *Honeybrook*. Repairs costing $158 were paid by the owners of the tug.

On August 9, 1914, Pollock Rip Light Vessel No. 47, Mass., was struck by the barge *Henry Failing* in tow of the tug *Concord*, causing damages to the extent of $785. The owners of the tug *Concord* have agreed to pay for the repairs.

On November 14, 1914, Pollock Rip Relief Light Vessel No. 9, Mass., was struck by a barge in tow of a tug. Cost of repairs $100. Efforts to ascertain the names of barge and tug have been unavailing.

On December 21, 1914, Seventy Four Bar Buoy, 10, was fouled by the steamer *Sloterdyk*. Estimated damage $150. As the accident was unavoidable, no action was taken to collect the cost of repairs.

On March 3, 1915, Handkerchief Light Vessel No. 4, Mass., was struck by a barge in tow of the tug *Pejebscot*, and damaged to the extent of $242, which amount was paid by the owners of the tug.

On April 23, 1915, the tender *Azalea* was struck by a barge in tow of tug *Pejebscot*. The cost of repairs, which amounted to $108.70, was paid by the owners of the tug.

On January 12, 1915, during a heavy northeast wind, float No. 51 of the New York Dock Co., drifted in the south slip at the general depot dock, Tompkinsville, N. Y., against the bulkhead, breaking two piles and injuring a small building on the bulkhead. Repairs costing $150 were made by the owners of the float.

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On September 23, 1914, the U. S. S. *Drayton* ran into the north side of the north dock at Tompkinsville, N. Y., damaging it to the extent of $171.50. On October 30, 1914, the U. S. S. *Monaghan* hit the southeast corner of the north dock, damaging it to the extent of $25. On November 7, 1914, the U. S. S. *Roe* hit the southeast corner of the north dock, damaging it to the extent of $229. The damages have been repaired by the Government.

On July 24, 1914, the schooner *Charles P. Finney* collided with Manokin River Light, Manokin River, Md. The light structure was rebuilt by the Government at a cost of $104.22, it being impracticable to fix responsibility for the accident.

On August 3, 1914, the tug *Parole* towing dredge *Nellie* and lighter collided with and destroyed Sewall Point Spit Light, Va. The expense of rebuilding the light structure was borne by the owners of the tug.

On December 15, 1914, the schooner *Lady Grant* collided with Great Island Light, Pamlico Sound, N. C. The light structure was replaced at a cost to the Government of $236.65, the schooner not being held responsible for the accident.

On March 6, 1915, the schooner *Addie M. Lawrence* collided with Thimble Shoal Light Station, Va. Repairs in the amount of $600 were made by the owners of the schooner.

On June 2, 1915, barge No. 4 of the New York, Philadelphia & Norfolk Railroad Co., broke away from the tow line of tug *Henrico* of the Southern Transportation Co. and collided with Craney Island Light Station, Va. The cost of repairing the light station in the estimated amount of $150 will be borne by the Government, neither the barge nor the tug being held responsible for the accident.

On June 22, 1915, the steamer *Ocean View* collided with and destroyed Sewall Point Spit Light, Va. The owners of the steamer have agreed to repair the damage in the approximate amount of $165.

On March 5, 1915, St. Johns Bluff Light No. 4, St. Johns River, Fla., was run into and damaged. It was found necessary later to rebuild the light at expense to Government, $121.32. All efforts to ascertain the name of the offending vessel have been unavailing.

On June 5, 1915, the lighthouse tender *Cypress*, lying alongside the customhouse dock, Charleston, S. C., was run into by the U. S. S. *Waban*. Estimated damages $881. Repairs will be made by the Government.

On January 21, 1915, Apalachicola Range Front Light, Fla., was run into and destroyed by the steamer *City of Eufaula*. Efforts are being made to have the owners of the steamer assume the cost of rebuilding the structure. Estimated cost of rebuilding structure, $825.

On February 13, 1915, Mobile Ship Channel Light No. 6A, Ala., was collided with by the schooner *C. W. Mills* in tow of the tug *Mary Wittich*. Cost of repairs $415.90. The matter of payment for repairs is in the hands of the United States attorney.

On March 2, 1915, the *S. S. Italia* collided with the tender *Sunflower* off Galveston Entrance, Tex., damaging the tender to the extent of $235, which was assumed by the steamship agents.

On May 6, 1915, Pascagoula River Entrance Beacon, 8, Miss., was destroyed by the United States dredge *Pascagoula*, War Department, engineer office, Mobile, Ala. Estimated cost for rebuilding, $190, which will be borne by the Government.

On November 11, 1914, Horseshoe Reef Gas Buoy, 3, Buffalo Harbor, N. Y., was struck by the steamer *Andrew F. Upson*, broken from its moorings and turned adrift. The bills for repairs, amounting to $581.01, were paid by the owners of the steamer.

On August 16, 1913, a construction scow belonging to the Lighthouse Service was collided with by the steamer *Joe S. Morrow* at Sault Ste. Marie, Mich., and completely demolished. Efforts were made to recover the value of the scow, approximately $350, from the owners of the vessel, but were later discontinued owing to the uncertainty of placing responsibility for the accident.[a]

On November 27, 1913, the steamer *C. F. Moll* collided with West Neebish Channel Light, No. 23, Mich., damaging the structure. The cost of repairs, amounting to $2.003.95, was paid by the owners of the steamer.[a]

On October 3, 1914, the suction from the steamer *J. Pierpont Morgan*, while bound through the Livingston Channel, Mich., swept the chartered barge *Eleanora* against a timber crib, sinking her with all Government construction material aboard, the latter valued at approximately $400. Loss was not recovered as the steamer was not held responsible.

On November 19, 1914, the French bark *Pierre Antonine* collided with the structure of the Desdemona Sands Light Station, Oreg. Repairs were made at a cost of $541. Suit was entered against the owners of the bark and the Government reimbursed.

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[a] Not included in annual report for 1914.

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On July 31, 1914, the steam schooner *James S. Higgins* collided with the Presidio Shoal Gas Buoy, Cal., damaging the lantern to the extent of about $150. The amount of the cost of repairs will be collected from the owners of the vessel.

In November, 1914, an unknown vessel knocked down and destroyed Redwood Creek Beacon No. 1, Cal. The beacon was replaced by the Government at a cost of $150.

During April, 1915, the Blind Point Echo Board in the San Joaquin River, Cal., was entirely destroyed, apparently by some unknown vessel. The estimated cost of replacing the echo board is $700.

The following damage was caused by vessels doing work of the Lighthouse Service during the year:

On August 15, 1914, the tender *Lilac* collided with a lobster car owned by the F. S. Willard Co., Portland, Me., damaging the car to the extent of $10.

On December 4, 1914, the tender *Tulip*, in order to avoid a collision with a schooner, backed into the dock of the Central Railroad of New Jersey, at Jersey City, N. J., damaging it to the extent of $289.84. The Lighthouse Service was responsible for these two collisions, and in accordance with section 4 of the act approved June 17, 1910 (36 Stat., 537), appropriations were recommended to Congress in the above amounts, ascertained to be due the claimants, which appropriations were made by the act of March 4, 1915.

PUBLICATIONS OF THE LIGHTHOUSE SERVICE.

[All publications are at present distributed free.]

Publication.	Date of last edition.	Cost of last edition.	Number distributed.
Light Lists:			
Atlantic and Gulf Coasts of United States	Jan. 1,1915	$4,840	11,536
Pacific Coast of United States, etc	do	1,195	3,011
Great Lakes of United States and Canada	Apr. 1,1915	2,179	4,935
Upper Mississippi River and Tributaries	July 15,1914	872	1,266
Ohio River and Tributaries	Sept. 15,1914	382	1,294
Lower Mississippi River and Tributaries	Oct. 20,1914	162	630
Buoy Lists:			
First district	Jan. 1,1914	1,157	366
Second district	do	949	493
Third district	May 1,1915	1,443	1,877
Fourth district	June 1,1915	307	5,111
Fifth district	May 15,1915	1,315	6,052
Sixth district	Jan. 1,1914	954	480
Seventh district	do	536	410
Eighth district	Aug. 15,1914	509	3,229
Ninth district	Dec. 15,1913	162	88
Tenth district	Apr. 1,1915	271	2,029
Eleventh district	do	580	1,503
Twelfth district	do	379	1,590
Sixteenth district	June 1,1915	253	551
Seventeenth district	Jan. 1,1914	649	250
Eighteenth district	do	399	79
Nineteenth district	June 30,1913	179	90
Miscellaneous publications:			
Weekly Notice to Mariners	1915	5,395	195,275
Annual Report, Lighthouse Board	1907	2,360	1
Do	1908	1,818	1
Do	1909	1,897	2
Do	1910	361	3
Annual Report, Commissioner of Lighthouses:			
Part I	1911	468	4
Part II	1911	680	.....
Part I	1912	572	7
Part II	1912	322	.....
Part I	1913	659	.....
Part II	1913	228	.....
Part I	1914	639	1,350
Part II	1914	281	.....
Regulations for the United States Lighthouse Service	1914	787	32
Instructions to light keepers	1911	49	10
Instructions to officers of vessels	1911	32	.....
Medical handbook	1912	440	53
Lighthouse Service bulletins	1915	204	16,325
Regulations for lighting bridges	1914	149	1,091
Regulations for uniforms	1912	70	113
Civil-service regulations	1913	73	12
Instructions for cost keeping	1914	120	132

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COST OF PRINTING FOR THE LIGHTHOUSE SERVICE DURING THE FISCAL YEAR 1915.

Light lists	$11,116
Buoy lists	4,327
Notices to mariners	5,395
Annual Report, Part I	639
Annual Report, Part II	281
Specifications and other publications	2,517
Forms, reports, record books, etc	5,952
Total	30,227

MONEY RECEIVED BY THE LIGHTHOUSE SERVICE AND TURNED INTO THE TREASURY, FISCAL YEAR 1915.

District.	From sales of vessels.	From sales of other property.	From damages to aids to navigation and other property.	From leases and rentals.
2d		$108.26	$90.20	$87.00
3d		8,380.43	99.86	106.00
4th		168.40		5.00
5th		1,357.07		
6th		1,834.24	3.85	16.00
7th			21.67	
8th		6.80		11.00
9th		9.95		
10th		422.22	101.08	723.00
11th	$313.27	1,343.51	20.00	1,037.05
12th		29.25		1.00
16th		79.05		
17th	99.04	399.25		214.72
18th				1,876.61
19th		140.25		
Bureau			199.91	

Total receipts, $19,304.94.

APPROPRIATIONS FOR THE BUREAU OF LIGHTHOUSES AND THE LIGHTHOUSE SERVICE, SIXTY-THIRD CONGRESS, THIRD SESSION, 1914–15.

Title.	Act.	Amount.
Maintenance:		
Salaries, Bureau of Lighthouses, 1916	Legislative, Mar. 4, 1915	$64,030
General expenses, Lighthouse Service, 1916	Sundry civil, Mar. 3, 1915	2,775,000
Salaries of keepers of lighthouses, 1916	....do	940,000
Salaries, lighthouse vessels, 1916	....do	1,010,000
Salaries, Lighthouse Service, 1916	....do	375,000
Total for maintenance		5,164,030
Special works: Lighthouse tender, general service	Urgent deficiency, Jan. 25, 1915	250,000
Grand total		5,414,030

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EXPENDITURES DURING THE FISCAL YEAR 1915 FROM APPROPRIATIONS FOR THE LIGHTHOUSE SERVICE.

[Obligations incurred are not included.]

MAINTENANCE APPROPRIATIONS.

Salaries:	
Bureau of Lighthouses, 1914	$2,770.48
Bureau of Lighthouses, 1915	60,428.79
Expenses of buoyage: Certified claims	509.93
Supplies of lighthouses: Certified claims	3.07
Lighting of rivers: Certified claims	12.50
Salaries of keepers of lighthouses:	
1914	27,237.23
1915	884,917.32
Certified claims	31.11
Expenses of light vessels: Certified claims	195.52
Maintenance of lighthouse tenders: Certified claims	774.49
Salaries, lighthouse vessels:	
1913	59.00
1914	34,442.22
1915	955,993.82
Salaries Lighthouse Service:	
1914	4,045.00
1915	359,140.73
General expenses, Lighthouse Service:	
1913	19,267.52
1914	448,890.85
1915	2,312,180.90
Certified claims	221.19
Total maintenance	5,111,120.94

SPECIAL WORKS.

General:	
Tender for first lighthouse district	38,767.12
Tender for fifteenth lighthouse district	20,780.22
Light vessels for general service	28,703.07
Lighthouse tender, general service	652.80
Oil houses for light stations	1,559.93
Light keepers' dwellings	2,237.58
Relief of employees of the Lighthouse Service	331.70
Claims for damages by collision with lighthouse vessels	6,648.11
Second district:	
Cape Cod Canal Lights, Mass.	23,784.45
Third district:	
Staten Island and West Bank Light Stations, N. Y.	274.35
Staten Island lighthouse depot, N. Y. (wharves)	10,707.07
Negro Point Light Station, N. Y.	322.87
Newark Bay beacon lights, N. J.	33.25
Rondout Creek Light Station, N. Y.	21,565.25
Point Judith Breakwater Lights, R. I.	1,840.20
Repairs to lighthouse tender *Pansy*	4,332.00
Fourth district:	
Miah Maull Shoal Light Station, Delaware River	871.73
Brandywine Shoal Light Station, Del.	31,291.14
Fifth district:	
Thimble Shoal Light Station, Va.	47,687.29
Chesapeake Bay lighted buoys	3,595.44
Lighting Norfolk Harbor, Va.	1,097.40
Fort McHenry Channel range lights, Md.	49,416.90
Sixth district:	
Cape Fear River lights, N. C.	1,062.32
Tender for engineer, sixth lighthouse district	435.67
Depot for sixth lighthouse district	60,774.48

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Eighth district:	
Galveston Jetty Light Station, Tex	$6,735.55
Southwest Pass Light Vessel, Mississippi River	1,485.59
Aids to navigation, Atchafalaya Entrance Channel, La	2,682.47
Ninth district: San Juan lighthouse depot, P. R	1,999.37
Tenth district:	
Buffalo Breakwater Light Station, N. Y	6,692.25
Point Abino Light Vessel, Lake Erie	9,859.53
Cleveland Fog-Signal Station, Ohio	203.92
Aids to navigation, Ashtabula Harbor, Ohio	8,605.85
Aids to navigation, Lorain Harbor, Ohio	1,331.95
Eleventh district:	
Aids to navigation, St. Marys River, Mich	3,610.41
Aids to navigation, Ashland, Wis	17,606.41
Detroit River lights, Mich	18,862.98
Superior Pierhead Range Lights, Wis	3,332.55
Twelfth district:	
Oconto Harbor lights, Wis	2,059.37
Milwaukee Light Vessel, Wis	406.07
White Shoal Light Station, Lake Michigan	516.49
Aids to navigation, Manistique, Mich	7,420.97
Sixteenth district:	
Aids to navigation, Alaska	23,061.36
Lincoln Rock Light Station, Alaska	15.59
Cape St. Elias Light Station, Alaska	12,010.49
Seventeenth district:	
Warrior Rock Light Station, Oreg	2,000.00
Aids to navigation, Puget Sound, Wash	6,322.45
Eighteenth district: Point Arena Light Station, Cal	1,582.43
Nineteenth district: Kauai Island Light Station, Hawaii	3,339.41
Total, special works	500,515.80
Total, maintenance appropriations	5,111,120.94
Total, special works	500,515.80
Grand total	5,611,636.74

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ITEMIZED ESTIMATES OF APPROPRIATIONS FOR THE FISCAL YEAR 1917, AND ITEMIZED STATEMENT OF EXPENDITURES FOR THE FISCAL YEAR 1915, AS REQUIRED BY THE ACT OF CONGRESS APPROVED JUNE 25, 1910 (36 STAT., 755).

[The expenditures herein stated are in part estimated, owing to the fact that all obligations incurred for the year 1915 have not yet been settled. Articles of supplies purchased for general stock have also been distributed, approximately, to features to be benefited. This table refers to appropriations made in the sundry civil appropriation act and does not include Bureau salaries in Washington nor the cost of publications, otherwise provided for.]

Item.	Estimate, 1917.	Expenditures, 1915.
GENERAL EXPENSES, LIGHTHOUSE SERVICE.		
Lights and fog signals:		
Rations and provisions	$161,000	$160,817
Fuel and rent for keepers	53,000	52,179
General supplies	208,000	205,217
Repairs and improvements, including grounds and outbuildings	346,000	342,377
Establishing lights and fog signals, including sites	65,000	65,001
Necessary additional land for light stations	1,500	50
Oil and carbide houses	2,000	157
Incidental expenses	8,000	7,712
Daymarks and spindles:		
Establishment, including sites	3,000	2,575
Repairs and improvements	9,000	8,400
Incidental expenses	250	253
Post lights:		
Establishment	8,000	6,165
Wages of laborers attending lights	235,000	233,610
Supplies	20,000	19,410
Repairs and improvements	15,000	13,932
Incidental expenses	1,000	989
Buoys:		
Establishment	150,000	149,417
Supplies	31,000	31,042
Repairs	47,000	45,806
Incidental expenses	750	675
Tenders:		
Rations and provisions	210,000	204,879
Supplies	365,000	352,000
Repairs	205,000	167,000
Incidental expenses	10,000	10,073
Light vessels:		
Rations and provisions	95,000	90,560
Supplies	115,000	113,821
Repairs	165,000	174,875
Incidental expenses	2,800	2,768
Depots:		
Pay of laborers and mechanics	57,000	55,895
Rent	5,500	5,040
Repairs and improvements	138,000	138,054
Incidental expenses	10,000	10,884
Offices:		
Technical books and periodicals	400	290
Stationery and office supplies	14,000	13,358
GENERAL EXPENSES, LIGHTHOUSE SERVICE—contd.		
Offices—Continued.		
Telegraph and telephone	$7,500	$7,689
Traveling expenses and mileage	35,000	35,255
Rent	6,000	5,661
Freight, expressage, and cartage	30,000	28,258
Motor cycle, Hawaiian Islands	300	.....
Incidental expenses	4,000	4,105
Total	2,840,000	2,766,249
Appropriation, 1916, $2,775,000.		
Appropriation, 1915, 2,775,000.		
SALARIES OF KEEPERS OF LIGHTHOUSES.		
Salaries of lighthouse keepers	940,000	907,031
Appropriation, 1916, $940,000.		
Appropriation, 1915, 940,000.		
SALARIES, LIGHTHOUSE VESSELS.		
Salaries and wages, lighthouse tenders	721,345	643,332
Salaries and wages, light vessels	378,655	347,819
Total	1,100,000	991,651
Appropriation, 1916, $1,010,000.		
Appropriation, 1915, 997,600.		
SALARIES, LIGHTHOUSE SERVICE.		
Salaries, executive and technical	150,600	134,392
Salaries, clerical and messenger	144,000	131,423
Salaries, authorized depot force	100,000	99,241
Total	394,600	365,056
Appropriation, 1916, $375,000.		
Appropriation, 1915, 375,000.		

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SUMMARY OF ESTIMATES OF APPROPRIATIONS FOR THE LIGHTHOUSE SERVICE FOR THE FISCAL YEAR 1917.

FOR GENERAL MAINTENANCE OF THE LIGHTHOUSE SERVICE.

Salaries, Bureau of Lighthouses	$67,230
General expenses, Lighthouse Service	2,840,000
Salaries, Lighthouse Service	394,600
Salaries, keepers of lighthouses	940,000
Salaries, lighthouse vessels	1,100,000
Total	5,341,830

FOR SPECIAL WORKS.

Group 1. Works urgently necessary for the safety of navigation and for the preservation of existing structures or equipment, for the full utilization of other public improvements, or for the completion of projects already commenced:	
1. Point Vincente, Cal., establishment of light and fog-signal station.	$80,000
2. St. Johns River, Fla., aids to navigation	66,000
3. Woods Hole, Mass., improvements to lighthouse depot	50,000
4. Fighting Island Channel, Mich., aids to navigation	25,000
5. Guantanamo, Cuba, building keepers' dwelling and improving the lighting	14,000
6. Florida Reefs, Fla., aids to navigation	75,000
7. Hudson River, N. Y., aids to navigation	100,000
8. Mississippi River, La., aids to navigation	50,000
9. Conneaut, Ohio, light and fog signal, and improving present aids to navigation	63,500
10. Kellett Bluff, Wash., establishment of light and fog signal station	40,000
11. Coquille River, Oreg., aids to navigation	6,000
12. Toledo Harbor, Ohio, aids to navigation	15,000
13. Pearl Harbor, Hawaii, aids to navigation	80,000
14. Dog Island, Me., establishment of light	3,500
15. Sandy Hook, N. J., aids to navigation	20,000
16. Delaware River, Pa. and Del., aids to navigation	80,000
17. Tender and barge for eighth lighthouse district, construction and equipment	20,000
18. Lighthouse tender to replace tender *Gardenia*, or for general service.	150,000
19. Light vessel for Cape Charles, Va., or for general service	130,000
20. Light vessels for general lakes service	150,000
Total group 1	1,218,000
Group 2. Works considered essential for the immediate needs of navigation and for the efficient equipment of the Lighthouse Service:	
21. Lighthouse depot for second district, construction	85,000
22. Detroit, Mich., improvements to lighthouse depot	53,000
23. Staten Island lighthouse depot, N. Y., improvement	21,000
24. Huron Harbor, Ohio, aids to navigation	4,500
25. Hawaiian Islands lighthouse depot, temporary structure	5,000
26. Hawaiian Islands lighthouse depot, construction and equipment	90,000
27. Point Borinquen Light Station, P. R., removal and rebuilding	85,000
28. Light keepers' dwellings, construction	75,000
29. Fairport, Ohio, aids to navigation	42,000
30. Sand Hills, Mich., establishment of light and fog-signal station	75,000
31. Manitowoc Breakwater Light Station, Wis., improvement	21,000
32. East River, N. Y., aids to navigation	16,000
33. Keweenaw Waterway, Mich., aids to navigation	110,000
34. Cape Charles City, Va., aids to navigation	12,800
35. Chesapeake Bay and tributaries, Md. and Va., Eastern Shore, aids to navigation	29,000
36. Alaska, aids to navigation	60,000
Total group 2	784,300

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Group 3. Works considered essential for the needs of navigation and the equipment of the Lighthouse Service, and which it is recommended be undertaken as resources permit, are submitted with estimates of cost. (These items have been selected from a much larger number of recommendations submitted by the inspectors of the lighthouse districts and others.)

37. Ludington, Mich., aids to navigation	$35,000
38. Tampa Bay, Fla., aids to navigation	12,000
39. Delaware Bay entrance, improvement of aids to navigation	75,000
40. Goose Island Flats, N. J., establishment of light and fog-signal station	120,000
41. Alaska, lighthouse depot, purchase of site and construction and equipment	50,000
42. Indian River, Fla., aids to navigation	8,500
43. Light vessel for South Pass, La., or for general service	125,000
44. Sand Island Light Station, Ala., improvements	45,000
45. Point Pinos Light Station, Cal., improvement	29,000
46. Spectacle Reef Light Station, Mich., improvements	20,000
47. Michigan Island, Wis., establishment of light and fog-signal station	100,000
48. Kauhola Point Light Station, Hawaii, improvement	19,000
49. Goat Island Lighthouse depot, Cal., improvements	51,000
50. Santa Barbara Light Station, Cal., improvements	29,000
51. Cape Spencer, Alaska, establishment of light and fog-signal station	100,000
52. Potomac River, Md., aids to navigation	120,000
53. Lighthouse depot for fifth district, enlargement, improvement, or establishment of new depot	275,000
54. Lighthouse tender, to replace tender *John Rodgers*, or for general service	150,000
55. Additional gas buoys, fifth lighthouse district	35,000
56. Chicago Harbor Light Station, Ill., removing and rebuilding	142,000
57. Cape Fear Light Station, N. C., removing and rebuilding, or protection	35,000
58. Hilo, Hawaii, aids to navigation	13,000
59. Portage Lake, Mich., establishment of light and fog-signal station and improvement of aids	100,000
60. Ram Island, Me., establishment of light	3,100
61. Cape Kumukahi, Hawaii, establishment of light	22,000
62. Washington and Oregon, aids to navigation	35,000
63. Henderson Point, Me., establishment of light and fog signal	3,800
64. Port Real, P. R., establishment of light station	34,000
65. Nine Mile Point, Mich., establishment of light and fog-signal station	50,000
66. Anacapa Island, Cal., establishment of light and fog-signal station	103,000
67. Caribbean Sea, aids to navigation	60,000
Total, group 3 (not included in total of estimates)	1,999,400

RECAPITULATION.

For general maintenance of the Lighthouse Service		5,341,830
For special works:		
Group 1	$1,218,000	
Group 2	784,300	
		2,002,300
Grand total		7,344,130

DETAILED ESTIMATES FOR MAINTENANCE, 1917.

BUREAU OF LIGHTHOUSES.

Salaries $67,230

GENERAL EXPENSES, LIGHTHOUSE SERVICE.

For supplies, repairs, maintenance, and incidental expenses of lighthouses and other lights, beacons, buoyage, fog signals, lighting of rivers heretofore authorized to be lighted, light vessels, other aids to navigation, and lighthouse tenders, including

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the establishment, repair, and improvement of beacons and day marks and purchase of land for same; the establishment of post lights, buoys, submarine signals, and fog signals; the establishment of oil or carbide houses not to exceed $10,000: *Provided*, That any oil or carbide house erected hereunder shall not exceed $550 in cost; the construction of necessary outbuildings at a cost not exceeding $500 at any one light station in any fiscal year; the improvements of grounds and buildings connected with light stations and depots; wages of laborers attending post lights; pay of temporary employees and field force while engaged on works of general repair and maintenance and pay of laborers and mechanics at lighthouse depots; rations and provisions or commutation thereof for keepers of lighthouses, working parties in the field, officers and crews of light vessels and tenders, and officials and other authorized persons of the Lighthouse Service on duty on board of such tenders or vessels; and money accruing from commutation for rations and provisions for the above-named persons on board of tenders and light vessels or in working parties in the field may be paid on proper vouchers to the person having charge of the mess of such vessels or parties; reimbursement under rules prescribed by the Secretary of Commerce of keepers of light stations and masters of light vessels and of lighthouse tenders for rations and provisions and clothing furnished shipwrecked persons who may be temporarily provided for by them, not exceeding in all $5,000 in any fiscal year; fuel and rent of quarters where necessary for keepers of lighthouses; the purchase of land sites for fog signals; the rent of necessary ground for all such lights and beacons as are for temporary use or to mark changeable channels and which in consequence can not be made permanent; the rent of offices, depots, and wharves; traveling expenses, including per diem in lieu of subsistence allowed pursuant to section 13 of the sundry civil appropriation act approved August 1, 1914, mileage, library books for light stations and vessels, and technical books and periodicals not exceeding $1,000; and for all other contingent expenses of district offices and depots and for contingent expenses of the Office of the Bureau of Lighthouses in Washington, $2,840,000.

Hereafter the Secretary of Commerce is authorized, whenever he shall deem it advisable, to exchange any right of way of the United States in connection with lands pertaining to the Lighthouse Service for such other right of way as may be advantageous to the Service, under such terms and conditions as he may deem to be for the best interests of the Government; and in case any expenses are incurred by the United States in making such exchange, the same shall be payable from the appropriation "General expenses, Lighthouse Service," for the fiscal year during which such exchange shall be effected.

Hereafter post-lantern lights and other aids to navigation may be established and maintained, in the discretion of the Commissioner of Lighthouses, out of the annual appropriations for the Lighthouse Service on the Mobile, Tombigbee, Warrior, and Black Warrior Rivers, Alabama.

Hereafter the appropriation "General expenses, Lighthouse Service" shall be available for the purchase, equipment, repair, and operation of motor-propelled vehicles for transporting passengers or freight for use of the Lighthouse Service in the Hawaiian Islands.

Hereafter light keepers and assistant light keepers of the Lighthouse Service shall be entitled to medical relief without charge at hospitals and other stations of the Public Health Service, under the rules and regulations governing the care of seamen of the merchant marine: *Provided further*, That this benefit shall not apply to any keeper or assistant keeper, who receives an original appointment after the passage of this act, unless the applicant passes a physical examination in accordance with rules approved by the Secretary of Commerce and the Secretary of the Treasury.

NOTE.—The amount estimated for is $65,000 in excess of the appropriation for the fiscal year 1916, consisting of the following items:

Leave of absence for per diem employees	$15,000
General increase of service	50,000
Total	65,000

The item of $15,000 for leave of absence of per diem employees is made necessary by the authority contained in the act of March 3, 1915 (38 Stat., 927). The granting of this leave is believed to be of benefit to both the employees and the Lighthouse Service, but in order that the work of the Service may not be delayed, it is necessary to provide funds to meet this expense.

The further increase of $50,000 is considered necessary on account of the increase in numbers of aids required for the safety of navigation and to keep the Lighthouse Service in an economical state of repair and efficiency. This increase of $50,000 is 1.8 per cent over the appropriation of the last two years, while the total number of aids was increased during the same period from 13,521 to 14,544, an increase of 1.023

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or 7.5 per cent. In order to keep pace with the constant development of commerce it is believed that proper provision for maintenance and repair as well as for the establishment of necessary additional minor aids frequently requested by mariners should be made. With the increasing numbers of requests for aids, it is impossible to render the full efficiency and service demanded unless adequate provision is made for funds.

The foregoing estimate of appropriation for "General expenses, Lighthouse Service," provides for the increase in the limit of cost of construction of necessary outbuildings at light stations in any fiscal year from $200 to $500. The limit of cost of $200 authorized for this purpose has been contained in appropriation acts since the fiscal year 1902, since which time the cost of labor and materials has greatly increased. The effect of restriction to this small limit has been to cause the erection of numerous small unsubstantial buildings at light stations, making the premises unsightly, rather than a smaller number of larger and better structures at a greater cost per building. It is not anticipated that there will be any increase in the total expenditure for this purpose, and the more permanent type of structure possible with a higher limit of cost will prove economical as well as improve the appearance of light stations.

Provision is also included for allowing commutation of rations and provisions to working parties of the Lighthouse Service in the field. The members of working parties of the Lighthouse Service are furnished their subsistence when employed away from their homes and stations, but there is no authority for commuting the allowance, it being necessary either to provide subsistence in kind or reimburse the individuals for expenditures made by them for this purpose. It will facilitate the work of subsisting field parties and reduce the amount of clerical work in district offices if authority for commuting this subsistence is granted.

Regarding the proposed legislation for exchanges of rights of way, it is desirable from time to time for the best interests of the Lighthouse Service to exchange existing rights of way over land leading to lighthouse reservations for more direct or suitable rights of way; but there is no existing law authorizing such changes, which it is now recommended that Congress grant in the authority requested above.

In connection with the estimate of appropriation submitted herewith authority is requested to establish and maintain post-lantern lights and other aids to navigation on the Mobile, Tombigbee, Warrior, and Black Warrior Rivers, Ala. The lighting of rivers or inland waters is limited to those specifically authorized by Congress, and such authority has not been granted for the waters herein specified. These rivers have been extensively improved by the building of locks under the War Department and an increasing commerce, principally of barges carrying coal, has been developed. Maritime interests in these localities have urged the establishment of aids, and investigation by the Lighthouse Service has shown that such action is warranted.

Authority is also requested for making the appropriation, "General expenses, Lighthouse Service" available for the purchase, equipment, repair, and operation of motor-propelled vehicles for carrying passengers or freight in the Hawaiian Islands. On account of the prohibition contained in the act of August 1, 1914 (38 Stat., 598), there is no appropriation available for this purpose. Except in the vicinity of Honolulu, travel in those islands is almost exclusively by automobile and on account of the long distances the expense is very high. It is desired to purchase a motorcycle for the use of foremen and other employees in connection with construction and repair work of the Service, which will effect a material saving in transportation expense and in the time of the employees.

Authority is also requested for extending the benefits of the Public Health Service to lighthouse keepers and assistant lighthouse keepers. The employees in question are mostly employed at isolated places and in many cases their compensation is such as to make it a hardship for them to bear the expense of illness or injury. There is already provision for the care and treatment by the Public Health Service of officers and crews of vessels of the Lighthouse Service, without charge, and it is considered just that the other employees named herein be given the same benefits. The proposed legislation has the approval of the Secretary of the Treasury.

It is further recommended that consideration be given to the consolidation of the four general maintenance appropriations under the single appropriation "General expenses," by naming in the consolidated general appropriation a specific amount as the limit of all salary items included therein. It is believed that this step would effect a more economical and efficient administration of the Lighthouse Service by simplification of the accounting system, and permitting the costs of work to be kept in a more systematic and comprehensive manner, showing clearly for each principal feature the relative amounts paid for salaries, materials, supplies, equipment, and other component items. Among additional advantages of consolidation of items of general appropriation may be stated the following: (a) Laborers in charge of lights are now paid out of two different appropriations, those attending lights on rivers

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authorized by Congress to be lighted being paid out of general expenses, and those at other lights not on rivers being paid out of salaries of keepers; (*b*) commutation of rations of keepers and other employees (which may be properly considered as part of their compensation) now must be paid out of the appropriation "General expenses," while the salaries proper are paid out of the respective salary appropriations; (*c*) the items recommended for consolidation have natural limitations. For example, the number and average salary of keepers is limited by law. A necessary limitation is also imposed by the number of vessels in service. If such a consolidation of appropriations may be effected, it is believed that the total sum of the four general maintenance appropriations stated in these estimates, viz, $5,274,600, may be reduced in the sum of $25,000 to a revised total of $5,249,600. This may be effected by reason of the fact that it is necessary to allow a small portion of each appropriation to be reserved for prevention of a deficiency prohibited by law, and if the appropriations be consolidated the amount reserved may be correspondingly reduced.

(See p. 629 for itemized estimate.)

SALARIES, KEEPERS OF LIGHTHOUSES.

For salaries of not exceeding 1,800 lighthouse and fog-signal keepers and laborers attending other lights, exclusive of post lights, $940,000.

NOTE.—This is the same amount as appropriated for the fiscal year 1916.

(See p. 629 for itemized estimate.)

SALARIES, LIGHTHOUSE VESSELS.

For salaries and wages of officers and crews of light vessels and lighthouse tenders, including temporary employment when necessary, $1,100,000.

NOTE.—The amount estimated for is $90,000 in excess of the appropriation for the fiscal year 1916, as per the following statement:

Present authorized complements of tenders	$675,930	
Present authorized complements of light vessels	365,316	
		$1,041,246
Complements of new tenders, fiscal year 1917	43,570	
Complements of new light vessels, fiscal year 1917	15,760	
		59,330
Radio operators on tenders		7,720
		1,108,296
Estimated lapsed pay		8,296
Total estimated for		1,100,000

The appropriation under this head for 1916 was $1,010,000, which is $31,246 less than the total of the present authorized complements on the vessels, so that in order to avoid a deficiency it will be necessary to lay up some vessels or reduce the crews. Similar conditions existed in the fiscal year 1915. It is therefore necessary to ask for a larger appropriation in order to keep all vessels in commission and maintain the efficiency of the Service. During the fiscal year 1917 it is expected that there will be in commission three new tenders and four new light vessels, in addition to those in service during the year 1915, for a whole or part of the year, for which a total of $59,330 for salaries and wages will be required, based on complements of similar vessels now in service.

The item of $7,720 for radio operators is intended to provide for the additional employees required for installations on lighthouse tenders. Three installations are already completed, for which there are not sufficient funds to provide operators, and 5 other installations are to follow as funds become available. The moderate installation of such equipment is believed to be an urgent matter for the best efficiency of the Service.

(See p. 629 for itemized estimate.)

SALARIES, LIGHTHOUSE SERVICE.

For salaries of 17 lighthouse inspectors, and of clerks and other authorized permanent employees in the district offices and depots of the Lighthouse Service, exclusive of those regularly employed in the office of the Bureau of Lighthouses, Washington, D. C., $394,600. Hereafter the annual salaries of lighthouse inspectors, excepting the inspector of the third lighthouse district, shall not exceed $3,000 each.

NOTE.—An increase of $19,600 over the appropriation for the fiscal year 1916 is submitted, consisting of the following:

Additional clerks and draftsmen	$10,000
Increase of salary for lighthouse inspectors	9,600
Total	19,600

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The item of $10,000 is occasioned by the general growth of the Service in order that the technical and clerical work of the district offices may be dispatched promptly. About 10 positions at salaries ranging from $900 to $1,500 per annum will be thus provided for.

The salaries of lighthouse inspectors are, by the act of June 17, 1910, limited to $2,400 a year, except the inspector of the third district, whose salary is fixed at $3,600. The salary of $2,400 is inadequate because of the heavy responsibilities with which the inspectors are charged and the technical and business ability required to successfully discharge the duties. The compensation of these positions should be sufficient to bring into and retain in the Lighthouse Service a class of persons fully competent to efficiently conduct such important work. The inspectors should be men of high character and qualifications, including technical knowledge as to engineering and nautical affairs, and business ability. The salaries of lighthouse inspectors are materially less than those of various other officers of the Government whose requirements and responsibilities are not considered to be any greater.

(See p. 629 for itemized estimate.)

DETAILED ESTIMATES FOR SPECIAL WORKS, 1917.

GROUP NO. 1.

Works urgently necessary for the safety of navigation and for the preservation of existing structures or equipment, for the full utilization of other public improvements, or for the completion of projects already commenced.

No. 1. *Point Vincente, Cal., Light Station.*—For establishing a light and fog-signal station at Point Vincente, Cal., $80,000.

NOTE.—The act of March 3, 1915 (38 Stat., 927), authorized this work, but no appropriation was made therefor. Point Vincente is the most prominent point of the California shore line between Point Loma and Point Conception, a distance of 220 nautical miles. Practically all steamer traffic on the Pacific coast south of San Francisco, both domestic and foreign, passes this point. There is at present no lighthouse on this point, but there is one at Point Fermin, 6¼ miles southeastward. This point, however, is cut off from steamers approaching on the usual courses from the northward until within 4 miles of Point Vincente by that point itself. This leaves an unlighted gap of 32 nautical miles on the usual courses of coasting vessels between Point Hueneme Light Station and Point Fermin Light Station. The Point Fermin light would be discontinued on the completing of this proposed light station, for the reason that with a light on Point Vincente and the new lighthouse at the entrance to Los Angeles Harbor it would be no longer required. Freight and passenger traffic is very heavy along this part of the coast and will be materially increased with the opening of the Panama Canal. Point Vincente is a bold, rocky point and practically no warning can be had by the lead in approaching it in foggy weather, as the 100-fathom curve lies within one-half mile of the shore. The importance of this point is increased by the fact that it is a point of change of course for all passing traffic. Petitions dated September 21, 1907, September 3, 1909, and October 28, 1909, signed by masters and shipowners, requested that a light and fog signal be established at this point. It is proposed to establish a flashing light at an elevation of 170 feet, and a first-class compressed-air fog signal. Detailed estimate:

Tower, including site and water supply	$31,000
Illuminating apparatus	5,500
Fog-signal apparatus and building	9,800
Dwellings for three keepers	19,000
Outbuildings, fences, oil storage, piping, etc.	7,000
Contingencies	7,700
Total	80,000

No. 2. *St. Johns River, Fla., aids to navigation.*—For improving the aids to navigation and establishing new aids on the St. Johns River, Fla., below Jacksonville, $66,000.

NOTE.—The act of March 3, 1915 (38 Stat., 926), authorized this work, but no appropriation was made therefor. The present project of the United States engineers calls for a 30-foot low-water channel from the sea to Jacksonville, and is expected to be completed by July 1, 1915. The increased depth in this river means that vessels of increased size will use this port. It will, moreover, be more than ever necessary to follow the dredged channels closely. The present post lights along the edges of the channels, already a source of much trouble and expense on account of damage by collision, if retained, would have to be moved even closer to the channels and into depths of water in which it would prove impracticable to maintain them. The present post-lantern lights are confusing by reason of their low intensity and fixed characteristic, and the large number of them necessarily visible at one time. The amount of commerce on this river is large and increasing and fully warrants any reasonable expenditure to establish an efficient system of lighted aids. It is proposed to establish 36 range lights, 14 post lights, and 21 buoys to mark this tortuous channel properly. Detailed estimate:

Foundations for 36 range lights	$14,400
Towers for same	3,600
Illuminating apparatus	22,000
14 post-light structures	1,400
16 gas buoys and appendages	21,600
5 nun buoys and appendages	1,000
Contingencies	2,000
Total	66,000

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No. 3. *Woods Hole, Mass., lighthouse depot.*—For improvements at Woods Hole lighthouse depot, Mass., $50,000.

NOTE.—The act of March 3, 1915 (38 Stat., 926), authorized this work, but no appropriation was made therefor. This depot is well located and protected in all weathers, but the work is badly handicapped by there not being a sufficient depth of water for tenders and deep-draft light vessels. It is recommended that the channel and basin around the wharf be dredged to a depth of 17 feet at low water, and it is also recommended that a brick storehouse, 35 by 80 feet, two stories high, with a half-pitch roof be built to replace the wooden one, which is not at all adapted for the work, and not large enough to accommodate the stock on hand in proper manner. Under present conditions the tender *Anemone* requires a supply of buoys on the fish commission dock and on the wharf at New Bedford, thus having the supplies located in three different places. The *Azalea* is required to tend and wait on the *Anemone* when anything is required from the depot's stock. This operation seriously interferes with carrying on the work properly. The dock at the fish commission is in a very dilapidated condition, and it is only a matter of a short time when the *Anemone* will not be able to dock there or keep a working supply of buoys and appendages. The front of the wharf has already been taken away and the remainder will not last for any great length of time. Detailed estimate:

Dredging channel	$35,000
Building storehouse	15,000
Total	50,000

No. 4. *Fighting Island Channel, Mich., aids to navigation.*—For improving aids to navigation and establishing new aids in the Fighting Island Channel, Detroit River, Mich., $25,000.

NOTE.—The act of March 3, 1915 (38 Stat., 927), authorized this work, but no appropriation was made therefor. The project for improvement of the lower Detroit River, contained in House Document No. 17, Sixty-second Congress, first session, for which an appropriation was made in the river and harbor act of March 4, 1913, is now in course of completion. This contemplates a straight channel after leaving the Grassy Island North Channel Range to the turn on to the Grosse Isle South Channel Range, a distance of some 5 miles. This will eliminate the necessity of both Mamajuda Range and Grassy Island South Channel Range, and necessitate the moving of both Ecorse Range, at the north end, and Grosse Isle North Channel Range, at the south, to proper sailing lines in the new channel.

The preferred scheme of lighting would be the establishment of separate ranges for up and down bound vessels, and of two or more side lights at about the present locations, on the west side of Grassy Island South and Mamajuda Ranges. Detailed estimate:

Establishing new range lights	$15,000
Moving present range lights	5,000
Establishing side channel lights	5,000
Total	25,000

No. 5. *Guantanamo, Cuba, aids to navigation.*—For dwelling for keepers of the lights in Guantanamo Bay, Cuba, and improving the lighting, $14,000.

NOTE.—The act of July 27, 1912 (37 Stats., 239), authorized the construction of these works, but no appropriation was made therefor. The dwelling at this station was destroyed during the late insurrection, and since the occupation of Guantanamo by the United States the keepers have been compelled to live in a wooden shack with only three rooms to house three keepers. The lights in charge of these three keepers are widely separated. With the installation of acetylene lights as proposed, the service of one keeper may be dispensed with. Detailed estimate:

Dwelling for two keepers	$8,000
2 acetylene lights at Fisherman Point	2,800
2 acetylene lights at Hicacal Beach	2,800
Contingencies	400
Total	14,000

No. 6. *Florida Reefs, Fla., aids to navigation.*—For establishing additional lighted aids for Florida Reefs, and repairs and improvements to existing aids, $75,000.

NOTE.—The act of March 3, 1915 (38 Stat., 926), authorized this work, but no appropriation was made therefor. On account of the unusually difficult and dangerous conditions encountered by vessels navigating near the Florida Reefs, especially by vessels bound into the Gulf of Mexico, which pass close to the reef to avoid the adverse Gulf stream current, additional lighted aids are urgently needed. A very large commerce is carried on through the Straits of Florida and numerous strandings and wrecks, involving large losses, have occurred in the past, several within the last year. These reefs, owing to their nature, are a grave danger to navigation. They rise steeply from the deep channel of the Straits of Florida and the lead is, therefore, of little assistance. They lie far from shore, and at night the mariner must rely almost entirely upon artificial aids to guide him clear. It is, therefore, proposed to provide four intermediate lighted aids to be located about midway between present lights, which it is believed would greatly decrease the present dangers of navigation in that vicinity. Detailed estimate:

Skeleton towers in place, Molasses Reef and Pacific Reef, with iron-pile foundations	$50,000
Illuminating apparatus for Molasses Reef and Pacific Reef	10,000
Gas buoys for Coffins Patches and Looe Key	10,000
Repairs and improvements to existing aids	5,000
Total	75,000

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No. 7. *Hudson River, N. Y., aids to navigation.*—For improving the aids to navigation and establishing new aids on the Hudson River, N. Y., $100,000.

NOTE.—The act of March 3, 1915 (38 Stat., 926), authorized this work, but no appropriation was made therefor. The lighting on the river is obsolete and many of the existing aids are in poor condition from age and so constructed that it is impossible to keep them in operation when the ice commences to move, and, as navigation is frequently open for a month in the fall of the year under these conditions, it is a great inconvenience and danger to navigation. Many complaints have been received from pilots and officials of Hudson River steamers, and correspondence with them has indicated a number of points at which improvements or new aids are considered necessary. With the large amount of traffic on this river and the size of passenger steamers navigating it at night, it is believed that a modern system of flashing lights, on concrete foundations so as to resist ice damage, would be of great assistance to navigation. It is proposed to rebuild the light and fog signal at Stony Point, which is in poor condition and far from the edge of the channel, to improve existing aids at Staats Point, Lamphere Dock, Four Mile Point, West Flats, and Con Hook, by providing brighter and flashing lights, to increase candlepower and provide fog bell at Jeffreys Hook, to rebuild decayed foundations and provide new towers and brighter lights at Bear Island, Cow Island, Nine Mile Tree, Roha Hook, Five Hook Island, New Baltimore, Fitch's Wharf, Percy Reach, Catskill West Flats, Livingston Creek, Upper Coal Beds, and Esopus Island, to rebuild tower and fog-bell house and improve the light at West Point, and to establish new lights at Van Wies Point, Barrytown Bluffs, Magazine Point, and Anthony's Nose, improving in all 20 existing lights and establishing 4 new lights. The cost of providing and moving suitable construction plant has also been included. Detailed estimate:

Rebuilding Stony Point	$15,000
Improving Staats Point, etc., 5 lights, at $2,500	12,500
Improving Jeffreys Hook with fog bell	5,500
Rebuilding and improving Bear Island, etc., 12 lights, at $3,000	36,000
Rebuilding and improving West Point	6,000
Establishing Van Wies Point, etc., 4 lights, at $4,000	16,000
Contingencies	9,000
Total	100,000

No. 8. *Mississippi River, La., aids to navigation.*—For improving the aids to navigation and establishing new aids on the Mississippi River, below New Orleans, La., $50,000.

NOTE.—The act of March 3, 1915 (38 Stat., 926), authorized this work, but no appropriation was made therefor. It is proposed to establish about 22 acetylene lens-lantern lights on skeleton steel towers, to take the place of the inefficient oil post-lantern lights now shown from wooden posts. Vessels traverse the river, drawing 28 feet of water. The commerce of the river is large and important. From January 1 to December 31, 1913, 3,662 coastwise and foreign-bound vessels, with a tonnage of approximately 8,140,000, entered the port of New Orleans. The imports and incoming coastwise shipments during 1913 were valued at approximately $101,000,000, and the exports and outgoing shipments approximately $213,000,000, making a total value of $314,000,000. Detailed estimate:

22 ramps and foundations	$12,000
22 steel towers, 30 feet high	9,000
22 illuminating outfits	25,000
Contingencies	4,000
Total	50,000

No. 9. *Conneaut, Ohio, aids to navigation.*—For a light and fog signal and improving the present aids to navigation in Conneaut Harbor, Ohio, $63,500.

NOTE.—The act of March 3, 1915 (38 Stat., 926), authorized this work, but no appropriation was made therefor. Extensive improvements to enlarge this harbor, involving the construction of new breakwaters and pierheads, and the removal of the breakwater pierhead upon which the present Conneaut Harbor Front Range Light and Fog Signal is situated, have been authorized and the construction of the breakwaters is in progress. The west breakwater pierhead is under contract to be completed this season. The harbor improvement will necessitate a rearrangement of the aids to navigation and it is proposed to build a suitable structure for the main light on the pierhead, the light to be an oil vapor flashing light and the present fog bell, which is inadequate, to be replaced with a modern compressed-air siren. The commerce of Conneaut Harbor is extensive. The annual number of vessels entering and departing is about 3,000, representing a total registered tonnage of approximately 9,000,000. Detailed estimate:

Concrete base	$20,000
Riprap	8,000
Superstructure	20,000
Illuminating apparatus	4,000
Fog-signal apparatus	8,000
Boats, piping, etc	3,500
Total	63,500

No. 10. *Kellett Bluff, Wash., Light Station.*—For establishing a light and fog-signal station at or near Kellett Bluff, Henry Island, Wash., or at some point on the west coast of San Juan Island, Wash., $40,000.

NOTE.—The act of March 3, 1915 (38 Stat., 927), authorized this work, but no appropriation was made therefor. Further investigation has shown that the best location for this light is at the Lime Kiln, on the west coast of San Juan Island, Wash. The greater part of the commerce between Puget Sound and Alaska, and between Cape Flattery and points on Georgia Strait will be benefited by the establishment of a light and fog-signal station at this point. Vessels proceeding to the northward after leaving Point Wilson have a run of about 32 miles before reaching the proposed location, with no fog signal on the American side. The depths are too great for soundings and there are strong tidal currents of uncertain direction to contend with. A light and fog-signal station will provide a definite point to run for in going north

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through Haro Strait, and a definite point of departure for vessels bound across the treacherous eastern end of Juan de Fuca Strait for Puget Sound, or bound northward through Haro Strait. This location is where it is customary for vessels to change course. It is important to the mariner that he verify his position here or in this vicinity in order to avoid the dangers on both sides of this narrow strait. A flashing light and a reed-horn fog signal are recommended. There is a reservation of land for lighthouse purposes on the west coast of San Juan Island. Detailed estimate:

Fog-signal building and tower	$12,000
Dwellings for two keepers	13,000
Illuminating apparatus	1,000
Fog-signal apparatus	4,000
One derrick and hoisting engine	1,000
Oil house, outbuildings, boats, walks, etc	5,400
Contingencies	3,600
Total	40,000

No. 11. *Coquille River, Oreg., aids to navigation.*—For improvement of aids to navigation at or near the entrance to Coquille River, Oreg., $6,000.

NOTE.—The act of March 3, 1915 (38 Stat., 927), authorized this work, but no appropriation was made therefor. Maritime interests have petitioned for the removal of the station to a more advantageous locality and much correspondence on the subject has been had during the past year. In its present location the light is of no great benefit to navigation, and the fog signal would serve its purpose better if on the other side of the river at or near the end of the south jetty. The station is on a point of land which is being encroached upon by the Coquille River. It is proposed to establish an occulting electric light and a fog bell operated by an electric motor at or near the end of the south jetty. A cottage for the keeper will be built near the inner end of the jetty on land formed by accretion since the construction of the jetty, or on a War Department reservation near by. The proposed change will effect an economy in the maintenance of the station, as only one keeper will be required instead of the present number of two. Detailed estimate:

Fog-signal building and tower	$1,500
Dwelling for keeper	2,500
Illuminating apparatus	200
Fog-signal apparatus	800
Electric wiring and poles	750
Contingencies	250
Total	6,000

No. 12. *Toledo Harbor, Ohio, aids to navigation.*—For improving the aids to navigation in Toledo Harbor, Ohio, $15,000.

NOTE.—The act of March 3, 1915 (38 Stat., 927) authorized this work, but no appropriation was made therefor. The Manhattan Range Lights, marking the axis of the Maumee Bay straight channel leading to Toledo, should be clearly visible after passing the Maumee Bay Range Lights for a distance of about 5 miles. The present lights are too low and are frequently obscured by smoke. They are also sometimes blanketed by vessels mooring in the lagoon. These lights should therefore be raised in order to give greater efficiency. The present wooden towers are not structurally adapted for raising, and it is proposed to replace them with steel towers. Detailed estimate:

Two steel towers, metal work	$10,000
Foundations	2,000
Erection, painting, installation	1,500
Contingencies	1,500
Total	15,000

No. 13. *Pearl Harbor, Hawaii, aids to navigation.*—For establishing aids to navigation in Pearl Harbor, Hawaii, $80,000.

NOTE.—The act of March 3, 1915 (38 Stat., 927), authorized this work, but no appropriation was made therefor. In view of the fact that the Government has authorized the establishment of a naval station at this point, it is important that the channels and entrance be properly marked: this is rendered more important by the set of the current, which is usually across the channel in the approach, and also on account of the prevailing northeasterly winds. The necessary aids to navigation should be available at the completion of the harbor improvements. It is proposed to establish 9 lighted and 9 unlighted beacons, also 2 gas buoys at the entrance. The Secretary of the Navy, by letter of August 12, 1913, requested favorable consideration for the establishment of suitable aids to navigation in Pearl Harbor. Detailed estimate:

2 gas lighted buoys	$10,000
4 lighted beacons in exposed waters, at $5,600	22,400
5 lighted beacons in unexposed waters, at $3,500	17,500
2 unlighted beacons in exposed waters, at $4,000	8,000
7 unlighted beacons in unexposed waters, at $2,100	14,700
Contingencies	7,400
Total	80,000

No. 14. *Dog Island, Me., light.*—For establishing a light at or near Dog Island entrance to St. Croix River, Me., $3,500.

NOTE.—The act of March 3, 1915 (38 Stat., 926), authorized this work, but no appropriation was made therefor. Several wrecks have occurred in this vicinity. The mean rise and fall of the tide is about 18 feet; and about 125,000 tons of freight are carried annually by this locality, in addition to frequent passenger service daily. It is recommended that an acetylene light with colored sector be established in the vicinity of Dog Island. Detailed estimate:

Tower, including site	$2,000
Illuminating apparatus	1,500
Total	3,500

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No. 15. *Sandy Hook, N. J., aids to navigation.*—For improving the aids to navigation at Sandy Hook, N. J., $20,000.

NOTE.—The act of March 3, 1915 (38 Stat., 926), authorized this work, but no appropriation was made therefor. North Hook Beacon Light and Fog Signal, N. J., are at present so located in front of the batteries at Fort Hancock, Sandy Hook, N. J., as to interfere very seriously with the gun fire of several of the batteries, and absolutely prohibits the training of the guns on the ranges covering the entrances to New York Harbor. The matter has been carefully investigated by representatives of the War Department and of the Lighthouse Service, and the views of maritime interests obtained relative to the best methods of making the necessary changes. It is recommended that the keepers' quarters, light, and fog signal be moved to a new location out of range of the batteries. Detailed estimate:

Moving and raising light, with new foundation	$7,000
Building new fog-signal house and moving engines	5,000
Moving, relocating, and repairing three keepers' dwellings	6,000
Contingencies	2,000
Total	20,000

No. 16. *Delaware River, Pa. and Del., aids to navigation.*—For improving the aids to navigation and establishing new aids on the Delaware River, Pa. and Del., $80,000.

NOTE.—The act of March 3, 1915 (38 Stat., 926), authorized this work, but no appropriation was made therefor. The United States Engineer's Office is now dredging a new 35-foot channel in the vicinity of Schooner Ledge, Delaware River. This channel will probably be completed during the present calendar year, and will require two ranges in place of the present Schooner Ledge Range. It is proposed to mark the new ranges as follows: Chester (Upper) Range, oil-vapor rear light on present reservation, acetylene front light in the water, out of the way of heavy ice; electric fog bell to be provided at the front light; Marcus Hook (Lower) Range to be similar, except that a site will be required for the rear light and no fog bell will be needed at the front light. Detailed estimate:

Chester Rear:		
Tower on pile and concrete foundation	$15,000	
Removal of old and display of temporary light	1,000	
Dwelling on pile and concrete foundation	8,000	
Elevated walks on pile foundations	4,000	
		$28,000
Chester Front:		
Tower and foundation	9,000	
Illuminating apparatus	2,000	
Fog-signal apparatus	2,000	
Riprap	2,000	
		15,000
Marcus Hook Rear:		
Site and right of way	6,000	
Tower, including dwelling	12,000	
Illuminating apparatus	3,000	
Oil house and outbuildings	1,500	
Grading roads, fences, etc	1,500	
		24,000
Marcus Hook Front:		
Tower and foundation	9,000	
Illuminating apparatus	2,000	
Riprap	2,000	
		13,000
Total		80,000

No. 17. *Eighth lighthouse district, tender and barge.*—For constructing, or purchasing, and equipping a small tender and barge for eighth lighthouse district, Texas and Louisiana, $20,000.

NOTE.—The act of March 3, 1915 (38 Stat., 926), authorized this work, but no appropriation was made therefor. The tender for the eighth lighthouse district, Texas and Louisiana, which should be a motor launch about 65 feet long, and barge to be equipped with derrick pile driver, neither to exceed 3 feet draft, are absolutely necessary for establishing and maintaining lights and daymarks along the intercostal canals and other shallow waters of the eighth lighthouse district. That portion of the canal from Galveston, Tex., to Corpus Christi, Tex., has been completed by the War Department, and in the next year or two the canal will be open to the Mississippi River. Detailed estimate:

Motor launch	$15,000
Pile driver derrick barge	5,000
Total	20,000

No. 18. *Tender for third lighthouse district.*—For constructing, or purchasing, and equipping a lighthouse tender to replace tenders worn out in service in the third lighthouse district, or in the Lighthouse Service generally, $150,000.

NOTE.—There are three tenders in the third district that are old and of obsolete types, and should be replaced as soon as practicable by modern efficient vessels. These are the *Gardenia*, *John Rodgers*, and *Mistletoe*. All of these tenders to be kept in commission require repairs that are not warranted by their age and the service obtained from them. At least one new tender for this district is an urgent present need.

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No. 19. *Cape Charles, Va., light vessel.*—For constructing and equipping a light vessel for station off Cape Charles, Va., or for general service, $130,000.

NOTE.—The light vessel now on Cape Charles station, which was built in 1890 and is of only 470 gross tonnage, and not self-propelling, breaks adrift from her moorings on frequent occasions, and on December 5, 1914, narrowly escaped destruction. The loss of moorings alone in the past year has amounted to over $3,500. Owing to the exposed station and the importance of this aid to navigation, a first-class self-propelling light vessel is required. Moreover, of the 66 light vessels in the service a number are more than 50 years old. To relieve these vessels for necessary repairs and overhauling and to place the older ships on less exposed stations, it is necessary that new vessels be added to the fleet.

No. 20. *Light vessels for general Lake service.*—For constructing and equipping light vessels for general service on the Great Lakes, or for general service, $150,000.

NOTE.—Light vessels *No. 55, No. 56, No. 57, No. 60, No. 61,* and *No. 62,* now stationed on the Great Lakes, are all old, built of wood, and are rapidly deteriorating. Light vessel *No. 59* was, during the summer of 1914, condemned as unseaworthy, and was removed from her station at Poe Reef, southern entrance to Straits of Mackinac, Mich. Of the others, light vessels *No. 61* and *No. 62* are in especially bad condition, and can not be depended upon for service in the stormy fall season. It is proposed to construct two or more vessels, similar in type to those recently built for Lake service, of steel, and fitted with modern light and fog-signal apparatus.

Total group No. 1, $1,218,000.

GROUP No. 2.

Works considered essential for the immediate needs of navigation, and for the efficient equipment of the Lighthouse Service:

No. 21. *Depot for second lighthouse district.*—For constructing and equipping a lighthouse depot for the second lighthouse district, $85,000.

NOTE.—The present depot of the second district for Boston Harbor and vicinity is on Lovells Island, and is there through the courtesy of the War Department only. It is not adapted or situated for a depot where the work can be carried on expeditiously. The tender can not lie there nights on account of being exposed to the weather, and passing steamers make such a swash that the tender's lines are parted. The tide has been known to cover the floor of the storehouse to a depth of 1 foot. The buildings, with the exception of the oil house, are wooden, and in poor condition of repair. The wharf is also in poor condition of repair. The Treasury Department has orders to transfer a piece of the old marine hospital property in Chelsea to the Lighthouse Service at the expiration of the present lease, which takes place December 31, 1916. This property by dredging will have three berths for vessels, ample storage room for buoys, and with a brick fire-proof storehouse would make a first-class depot. Detailed estimate:

Wharf	$10,755
Sea wall	11,732
Oil house	1,500
Service building	34,554
Depot keeper's dwelling	6,228
Storehouse	2,644
Machine and blacksmith shop	2,163
Buoy skid and chain platform	1,090
Dredging	6,000
Removing present structure from grounds	600
Excavating and laying water pipes	480
Boundary fence	1,395
Contingencies	5,859
Total	85,000

No. 22. *Detroit, Mich., lighthouse depot.*—For improvements at Detroit, Mich., lighthouse depot, $53,000.

NOTE.—The following improvements are needed:

Oil house: The arrangements for storage of oil at this depot are very inadequate and unsatisfactory, and oil is stored in one wing of the basement of the main storehouse. The capacity is, however, insufficient, making it necessary to store large quantities of oil in the depot yard, exposed to possible damage or total destruction by fire, owing to the proximity of a varnish works. Furthermore, the handling of oil would be greatly facilitated, as the new structure could be so located as to handle the oil directly from the cars.

Addition to lamp shop: The present lamp shop is greatly overcrowded, owing to the increasing number of lighted buoys and other aids in the district, necessitating a greater and increasing quantity of parts returned for repair. Spare parts can not be accommodated but must be stored in the main storehouse, inconveniently located for the work. It is necessary to do a great deal of blacksmith repair work to moorings of buoys, etc., at the depot during the closed season of navigation, and this work must now be done in the open part of the buoy shed under very severe weather conditions during the winter or at times delayed until the severe storms are over.

Storehouse for cement and lime: Owing to the large amount of construction and repair work necessary in this district, a considerable quantity of cement and lime must be kept on hand. A small building for this storage should be provided.

Reconstruction of wharf: The wharf here has undergone for many years only such repair as necessary to render it serviceable. It is an old wooden structure on cast-iron columns standing on piles cut off about a foot below water level. It should be rebuilt and extended out to the pier line to give additional capacity.

Detailed estimate:

Oil house	$4,000
Addition to lamp shop	5,000
Cement and lime storage	2,000
Reconstruction of wharf	38,000
Contingencies	4,000
Total	53,000

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No. 23. *Staten Island, N. Y., lighthouse depot.*—For improvement of the offices and laboratory at the general lighthouse depot, Tompkinsville, Staten Island, N. Y., $21,000.

NOTE.—The present office quarters and laboratory at the general depot, Tompkinsville, N. Y., are located in four detached buildings, giving rise to delay and confusion in the orderly handling of work, as well as causing unnecessary expense of heating and other maintenance items. It is proposed to construct an addition which will join three of the present buildings, and make it possible to use the space so gained for the improvement of the laboratory, which is now located in the fourth building. This building is poorly adapted for laboratory purposes, but can be put to good use as a storehouse, which is also needed on account of the growth of the Service. Detailed estimate:

Altering old buildings	$4,500
Foundation	1,500
Walls, rough floors, and roof	8,000
Interior finish, etc	5,000
Contingencies	2,000
Total	21,000

No. 24. *Huron, Ohio, aids to navigation.*—For establishing aids to navigation at Huron Harbor, Ohio, $4,500.

NOTE.—The act of June 17, 1910, authorized the establishment of range lights at Huron Harbor, at a cost not to exceed $3,800, but no appropriation for the object has been made. The erection of a rear range light to serve with the present Huron Light will accomplish the desired object, but provision should also be made for a fog bell at the front light. The commerce of Huron Harbor is important, consisting principally of ore and fish incoming and coal outgoing. Over 300 vessels with a registered tonnage of over 640,000 enter the harbor annually, with a cargo valuation of approximately $3,000,000. Detailed estimate:

Tower	$1,500
Illuminating apparatus	1,800
Fog-signal apparatus	1,200
Total	4,500

No. 25. *Hawaiian Islands, lighthouse depot.*—For constructing and equipping a temporary lighthouse depot at Honolulu, T. H., pending the establishment of a permanent depot, and authority is hereby granted to erect such temporary depot on land to be leased, $5,000.

NOTE.—On account of the dilapidated condition of the Territorial building on the channel wharf now occupied as a temporary depot, and the uncertain tenure of this building as a depot, efforts have been made to rent an adequate storehouse, but it was impracticable to secure a single building for this purpose. Should the Territory request the channel wharf vacated, the Lighthouse Service in the Hawaiian Islands would be deprived of all depot facilities. It is therefore recommended that appropriation for the erection of a temporary storehouse be made at the earliest possible date, to provide for the needs of the Service until a permanent depot can be established, for which a separate appropriation has been asked. Detailed estimate:

General storehouse with proper shelving	$5,000

No. 26. *Hawaiian Islands lighthouse depot.*—For the construction and equipment of a lighthouse depot for the nineteenth lighthouse district, $90,000.

NOTE.—The greatest need in this district is an adequate lighthouse depot. At present the stores are kept in two small, overcrowded, leaky storerooms on the Channel Wharf, Honolulu, where they are in danger of fire on account of proximity to fishing sampans, which are careless in the handling of gasoline. The heavy stores are kept in a large room adjoining the storage rooms occupied as a depot on Channel Wharf, lately vacated by the Territory because of the condemnation of the wharf. Buoys are kept some on Channel Wharf and some on Naval Wharf No. 1. The heavier buoys can not be kept on the Channel Wharf on account of its dilapidated condition, and when placed on the Naval Dock are exposed to the weather, and are frequently covered with coal when warships are coaling. In assembling materials for any construction work it has been the custom to collect them at the Channel Wharf, and if there is any considerable amount that wharf becomes filled up, necessitating the removal of the material on account of inconvenience to other users. Hence, the lack of a depot results in much inefficiency in collecting materials as well as inconvenience and annoyance. The fact that the temporary wharf and storehouse are in a bad state of repair, having been condemned about a year ago, makes the situation very uncertain and unsatisfactory. Application for the transfer of Naval Wharf No. 3 and of a piece of land (1.2 acres) contiguous to this wharf has been made to the Navy Department. It is proposed to erect adequate buildings and improvements on this site for lighthouse-depot purposes. Detailed estimate:

Repairs and enlargement of wharf	$30,000
General storehouse	28,000
Repair plant equipment	10,000
Carbide and oil house	2,000
Office building	10,000
Improvement of grounds, including walks, fences, etc	2,000
Contingencies	8,000
Total	90,000

No. 27. *Point Borinquen, P. R., Light Station.*—For the removal and rebuilding on another site of the light station and dwelling at or near Point Borinquen, P. R., $85,000.

NOTE.—The present Point Borinquen Lighthouse is improperly located at the foot of a bluff 230 feet high, which obscures the light in the northeasterly direction. To the southward, plantations of high trees obscure the light in its most desirable direction, the harbor of Aguadilla. The present tower is in bad state of

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repair, the top part being considered unsafe and the foundation insecure. At the present time the light is inadequate, and with the opening of the Panama Canal it is quite insufficient, as it has now become a most important landfall light. In addition to the light, and in connection with it, it is proposed to install a wireless station which will send automatically the wireless name of the station, which will give vessels an opportunity to locate their position when distant from the shore. Detailed estimate:

Tower, including site	$30,000
Dwelling for three keepers	20,000
Illuminating apparatus	7,000
Power house and wireless outfit	4,500
Outbuildings, piping, etc	8,000
Roads and grounds	7,000
Contingencies	8,500
Total	85,000

No. 28. *Light keepers' dwellings.*—For light keepers' dwellings and appurtenant structures, including sites therefor, within the limit of cost fixed by act approved February 26, 1907, $75,000.

NOTE.—The appropriations made March 4, 1907 (34 Stat., 1319), and May 27, 1908 (35 Stat., 334), of $75,000 each, are now exhausted, but dwellings at a number of stations are yet needed, among which may be stated: Amelia Island, Fla.; Ano Nuevo Island, Cal.; Buffalo Breakwater, N. Y.; Charlotte, N. Y.; Dry Tortugas, Fla.; Frankfort, Mich.; Oswego Breakwater, N. Y.; Piedras Blancas, Cal.; Point Hueneme, Cal.; Point Montara, Cal.; Point Sur, Cal.; Port San Juan, P. R.; Sand Island, Ala.; Tawas, Mich.; Toledo Harbor, Ohio; Two Harbors, Minn.; Ludington Breakwater, Mich.; Poverty Island, Mich. Detailed estimate:

16 dwellings, at $4,500	$72,000
Contingencies	3,000
Total	75,000

No. 29. *Fairport, Ohio, aids to navigation.*—For improving the aids to navigation at Fairport Harbor, Ohio, $42,000.

NOTE.—The completion of the west breakwater pierhead necessitates a rearrangement of the aids to navigation at this harbor. It is proposed to discontinue the present main light on the bluff and to construct the new light with a fog signal on the pierhead. The west breakwater and pierhead have been completed, and on the east side the breakwater has been built up to the water line throughout its length and the pierhead crib has been placed. The annual number of vessels entering and departing is about 1,300, representing a total registered tonnage of approximately 3,000,000. Detailed estimate:

Structure	$24,000
Illuminating apparatus	6,500
Fog-signal apparatus	8,000
Boats, piping, etc	3,500
Total	42,000

No. 30. *Sand Hills, Mich., Light Station.*—For establishing a light station and fog signal at or near Sand Hills, Mich., $75,000.

NOTE.—A light and fog-signal station at Sand Hills, about 4 miles west of Eagle River, Keweenaw Peninsula, Lake Superior, would be of great service to vessels bound east from the western portion of Lake Superior in warning vessels from the dangerous reefs off the coast. It is reported that 10 vessels stranded on these reefs in recent years, with known losses of over $1,000,000. Detailed estimate:

Tower	$30,000
Fog signal	12,000
Quarters for three keepers	15,000
Outbuildings, dock, boat, etc	10,000
Contingencies	8,000
Total	75,000

No. 31. *Manitowoc Breakwater, Wis., Light Station.*—For improving the light and fog-signal station at Manitowoc North Breakwater, Wis., $21,000.

NOTE.—The present frame building with corrugated iron covering, with very small wooden lantern (not large enough to admit a man) stands on the outer end of the North Breakwater, which is of stone-filled timber construction. The building is old and in poor condition. The timber sills supporting the building are badly rotted. The other timber work is deteriorating. Covering plates are rusting and breaking away at bottom. Cement floor is cracked and the building itself is shaky, due to movement and settlement of pier and to the fact that the building has been moved twice. It is liable to destruction in its exposed position and should be replaced at an early date with a steel building on a concrete base. It is proposed to install an electric-driven air compressor, obtaining current from the city, with oil engine reserve drive, and to provide a brighter light. Detailed estimate:

New fog-signal building, with lantern	$8,500
Fog-signal apparatus	6,500
Illuminating apparatus	4,100
Contingencies	1,900
Total	21,000

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No. 32. *East River, N. Y., aids to navigation.*—For improving the aids to navigation on the East River, N. Y., $16,000.

NOTE.—Improvements and changes in system of lights in East River, N. Y., in vicinity of Hell Gate are very much needed, for the present system is inefficient as well as difficult to maintain, especially during the winter with running ice in the river. An appropriation for improving and changing these aids, building new foundations, and establishing acetylene lights in place of present oil lights at Mill Rock Northerly Light, Lawrence Point Ledge Light, Sunken Meadow Light, South Brother Island Ledge Light, Rikers Island Light is recommended. Oak Bluff Light, which is at present of very little service on account of many shore lights now in the vicinity, can be discontinued. Detailed estimate:

Foundations	$9,000
Steel towers and tank houses	1,000
Gas tanks and lighting apparatus	6,000
Total	16,000

No. 33. *Keweenaw Waterway, Mich., aids to navigation.*—For establishing and improving aids to navigation at or near the entrance to Keweenaw Waterway Harbor of Refuge, Portage River, Mich., $110,000.

NOTE.—The improvements by the War Department are now in progress and will probably be carried through to completion at an early date. Steps should be taken as soon as possible by the Lighthouse Service looking to the proper lighting of the entrance under the new conditions. It is recommended that a light and fog signal be erected on a separate foundation on the outer end of the breakwater, and that six nonattended lights be established to mark the harbor, and, as the work will necessitate changes at the locality, that present range lights Nos. 1 and 2 be rebuilt and provided with gas appliances. The Portage River (Main) Light may be discontinued on the completion of this project, and the dwelling retained as shore station for one keeper. Detailed estimate:

Foundation and concrete base for tower	$43,000
Superstructure	24,000
Illuminating and fog-signal apparatus	9,000
Establishing six minor lights	24,000
Rebuilding lights Nos. 1 and 2	6,000
Contingencies	4,000
Total	110,000

No. 34. *Cape Charles City, Va., aids to navigation.*—For improving lights and fog signals leading to Cape Charles City, Va., $12,800.

NOTE.—Harbor improvements at this point in recent years have rendered Cherrystone Light and Fog Signal of little use in the present location. A new light and fog bell should be established close to turn in dredged channel and range lights should be established for dredged channel. It is proposed to establish acetylene gas lights and electrically operated fog-bell strikers. The illuminating apparatus on existing aids in this harbor should be improved by the installation of acetylene gas instead of present oil lights. Detailed estimate:

New concrete structure for light and fog bell	$2,500
Illuminating apparatus	1,500
Fog-bell striker and electric cable	2,820
Structural steel tower and foundation	1,000
Apparatus for three acetylene range lights	3,180
Apparatus for two minor lights in vicinity	800
Contingencies	1,000
Total	12,800

No. 35. *Chesapeake Bay, Md. and Va., aids to navigation.*—For establishing and improving aids to navigation on the eastern shore of Chesapeake Bay and tributaries, Maryland and Virginia, $29,000.

NOTE.—The eastern shore of Chesapeake Bay presents an intricate system of waterways which are inadequately lighted. The deep channels are narrow and crooked, and the wide flats are covered by only a few feet of water. The interests of a large part of the population of this country are maritime, large numbers of passengers are carried on regular lines of steamers to many ports, great quantities of truck and other produce move by water to Baltimore, and the fish, crab, and oyster industries are very important. The following items are considered necessary to provide an adequate system of lighted aids for these waters. Detailed estimate:

20 structures for minor lights	$6,000
15 acetylene equipments	6,000
5 oil equipments	300
5 structures, unlighted beacons	1,500
12 gas buoys and moorings	14,400
Contingencies	800
Total	29,000

No. 36. *Alaska, aids to navigation.*—For the establishment of aids to navigation and the improvement of existing aids in Alaska, $60,000.

NOTE.—The appropriation of $60,000 made by the act of August 1, 1914, will be practically exhausted when the construction of aids already authorized has been completed. Maritime interests are urging the establishment of additional aids to assist the mariner in Alaskan waters, where navigation is unusually difficult and dangerous and where wrecks and costly accidents to vessels are of frequent occurrence. The commerce of the district is increasing in volume, owing in part to the opening of the Panama Canal and

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the inauguration of construction work on the Government railroad, and new routes of navigation are being opened up. Additional fog signals are needed on the principal channels of southeastern Alaska, and additional unwatched lights should be installed as soon as possible on the main route from Ketchikan to Skagway, in Icy Straits, in Peril Strait, and Sitka Sound, on the west coast of Prince of Wales Island, in Prince William Sound, and on the coast between Resurrection Bay and Cook Inlet. Detailed estimate:

17 lights	$26,400
3 gas buoys	9,600
2 fog-signal installations	24,000
Total	60,000

Total group No. 2, $784,000.
Total groups Nos. 1 and 2, $2,002,300.

GROUP No. 3.

Works considered essential for the needs of navigation and the equipment of the Lighthouse Service, and which it is recommended be undertaken as resources permit, are submitted with estimates of cost. (These items have been selected from a much larger number of recommendations submitted by the inspectors of the lighthouse districts and others.)

No. 37. *Ludington, Mich., aids to navigation.*—For improving the aids to navigation and establishing new aids at Ludington, Mich., $35,000.

NOTE.—The present location of the fog-signal station on the end of south pier subjects vessels to danger of striking the breakwater. The commerce of Ludington, which includes important car ferry lines across Lake Michigan, is more important than any other port on the east shore of Lake Michigan, and as this port is most inadequately lighted now this improvement is considered well warranted. It is proposed to establish a main light on the outer end of the north breakwater, with fog-signal apparatus, consisting of electrically driven air compressor and siren with oil engine reserve drive, and to discontinue the present steam fog signal in old wooden structure. Quarters for keepers should be erected adjacent to the light, as it is unsafe to cross the harbor during the winter when the ice is broken up by car ferries. Detailed estimate:

Foundation and tower	$4,590
Fog-signal building	2,600
Illuminating apparatus	2,350
Fog-signal apparatus	6,500
Quarters for three keepers, including site	15,950
Minor lights on north and south pierheads	2,600
Contingencies	410
Total	35,000

No. 38. *Tampa Bay, Fla., aids to navigation.*—For establishing and improving aids to navigation in Tampa Bay, Fla., $12,000.

NOTE.—Tampa is an important seaport with a large and growing commerce by sea. Owing to shallow water in Tampa Bay, deep-draft vessels can reach the city from the Gulf only by means of several comparatively narrow dredged cuts. Provision has already been made for lighting all of the important cuts excepting Cut D, for which lights should be provided as soon as practicable, as large vessels must pass through this cut in order to reach Port Tampa. Detailed estimate:

Concrete foundation	$2,000
Metal work towers	5,000
Illuminating apparatus	4,000
Contingencies	1,000
Total	12,000

No. 39. *Delaware Bay entrance, aids to navigation.*—For improving the aids to navigation at the entrance to Delaware Bay, $75,000.

NOTE.—In consequence of the continued erosion of the shore line in the vicinity of Cape Henlopen Light, Del., the early destruction of that light is anticipated, measures taken for the preservation of the shore line having proved unavailing. Every purpose now served by Cape Henlopen Light would be better served by the rebuilding of Harbor of Refuge Light to a height of about 140 feet. The establishment of large gas buoys is also required, one midway between, and in the line connecting Five Fathom Bank Light Vessel and Overfalls Light Vessel, one at the extreme lower and outer end of Hen and Chickens Shoal, and one in approximately the present position of Fifteen Foot Shoal Buoy. With the improvements recommended herein, including a red sector in the new Harbor of Refuge Light to cover Brown Shoal, the ultimate fate of Cape Henlopen Light will have no bearing on the practical needs of navigation in this vicinity. Detailed estimate:

Rebuilding Harbor of Refuge Light Station	$56,676
3 gas and bell buoys on station	10,770
1 relief gas and bell buoy	3,590
2 extra gas tanks	1,160
2 extra 375 mm. lanterns	1,770
Sinkers and moorings for buoys	1,034
Total	75,000

No. 40. *Goose Island Flats, N. J., Light Station.*—For establishing a light and fog signal at or near Goose Island Flats, N. J., $120,000.

NOTE.—Vessels navigating the Delaware River are obliged to make a decided turn at this point. A temporary structure, protected by riprap, was carried away by the ice in January, 1910, although the

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riprap is partially in place and forms a menace to navigation unless properly marked. A buoy is now maintained at this location, but in winter it is impossible to keep it in position on account of the heavy ice. It is proposed to erect a light and fog signal, on a suitable heavy caisson foundation, close to the channel on the easterly side. Detailed estimate:

Foundation in place	$65,000
Metal work for superstructure	18,000
Erection of superstructure	20,000
Illuminating apparatus	3,000
Fog signal apparatus	5,000
Contingencies	9,000
Total	120,000

No. 41. *Alaska, lighthouse depot.*—For the purchase of a site for a lighthouse depot and the necessary equipment so far as funds may permit for the sixteenth lighthouse district, $50,000.

NOTE.—There is no lighthouse depot in Alaska, and the work of the lighthouse service is considerably handicapped by the lack of such facilities. Temporary quarters are now rented at $325 per month, which would be unnecessary if proper facilities were owned by the Government. It is not intended at this time to erect office quarters, etc., for which further arrangements in other Federal buildings may be made in the future. Detailed estimate:

Purchase of site	$40,000
Repairs, equipment, dock, etc	10,000
Total	50,000

No. 42. *Indian River, Fla., aids to navigation.*—For improving the aids to navigation and establishing new aids on the Indian River, Fla., $8,500.

NOTE.—There has been a demand for lights on this river for some time past, and the traffic thereon has increased considerably. The river is navigable for light-draft vessels for a distance of over 100 miles, and it has been improved by dredging in many places under authority of Congress. It is proposed to establish about 30 lights, which it is believed will be sufficient for the purpose. Detailed estimate:

30 pile dolphins	$3,750
20 oil lights	350
10 acetylene lights (for the more isolated localities)	3,500
Contingencies	900
Total	8,500

No. 43. *South Pass, La., light vessel.*—For constructing and equipping a light vessel for South Pass entrance to Mississippi River, La., or for general service, $125,000.

NOTE.—The act of October 22, 1913 (38 Stat., 224), appropriated $125,000 for a light vessel for Southwest Pass, but did not provide for South Pass, where there is urgent need for a similar vessel, as both passes are open and used. In the year 1913 over 3,600 vessels, with a tonnage of over 8,000,000, entered the port of New Orleans, and the total value of imports and exports during that period was over $314,000,000. It is proposed to construct a steel self-propelling vessel equipped with modern light and fog-signal apparatus, similar to that authorized for Southwest Pass.

No. 44. *Sand Island Light Station, Ala.*—For improving Sand Island Light Station, Ala., $45,000.

NOTE.—In October, 1906, a storm destroyed the dwelling at this station, and since that time the keepers have used the tower as a dwelling. These quarters are not suitable, and it is recommended that a dwelling be erected. There is great need for a fog signal at this station, which at present has none. Fog prevails for a large portion of the winter and spring season, making the entrance to Mobile Bay difficult and dangerous at times. It is recommended that the station be equipped with modern fog-signal apparatus. The brick tower, which was originally erected on Sand Island, now stands surrounded by an artificial island of rock, the sand island having washed away. The quantity of rock protection around the tower should be increased, about 3,000 tons of rock being required. Detailed estimate:

Riprap	$26,000
Dwelling for three keepers	8,000
Fog signal building	3,000
Fog-signal apparatus	7,000
Contingencies	1,000
Total	45,000

No. 45. *Point Pinos, Cal., Light Station.*—For improving Point Pinos Light Station, Cal., $29,000.

NOTE.—Improvements to the combined tower and dwelling at this station are required to keep them in a serviceable condition. Fogs are of frequent occurrence at this point, and a first-class compressed-air signal, together with quarters for two additional keepers, are urgently required. Traffic into Monterey Harbor is steadily increasing and a number of large oil-carrying steamers now run regularly to this port, where oil is piped from the oil fields in the interior of the State. Detailed estimate:

Fog-signal building	$3,000
Fog-signal apparatus	7,000
Dwellings for two keepers	12,000
Improvements to present station	4,500
Contingencies	2,500
Total	29,000

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No. 46. *Spectacle Reef Light Station, Mich.*—For improving Spectacle Reef Light Station, Mich., $20,000.

NOTE.—The wall surrounding the tower and supporting the fog-signal building and boathouse is disintegrating at the water line and should be repaired before further damage occurs. It is proposed to place a belt of steel flashing around the entire pier, commencing about 4 feet below the water line and extending about 3 feet above, fastening the same by heavy expansion bolts and back filling the voids with concrete after placing the plate. Detailed estimate:

Steelwork in place	$7,500
Concrete backing	6,000
Anchor bolts	3,500
Contingencies	3,000
Total	20,000

No. 47. *Michigan Island Light Station, Wis.*—For establishing a light and fog-signal station on Michigan Island (Lake Superior), Wis., $100,000.

NOTE.—The act approved May 27, 1908 (35 Stat., 332), appropriated $2,000 to make a survey and estimate the cost and report upon the feasibility and need of establishing a light and fog signal upon Gull Island or the easterly end of Michigan Island, Apostle Group. As a result of this survey, the conclusion has been reached that the eastern end of Michigan Island is the better site. The act of June 17, 1910 (36 Stat., 536), authorized the construction of a light and fog-signal station at Michigan and Gull Islands at a cost not to exceed $140,000, but no appropriation has been made therefor. Detailed estimate:

Tower and fog-signal building	$45,000
Illuminating apparatus	7,000
Fog signal	9,000
Dwellings for three keepers	18,000
Outbuildings, boats, etc.	6,000
Fences, walks, derricks, etc.	5,000
Contingencies	10,000
Total	100,000

No. 48. *Kauhola Point, Hawaii, Light Station.*—For improving the light station at Kauhola Point, Hawaii, $19,000.

NOTE.—Owing to the importance of this station, located near the northern point of the Island of Hawaii steps have been taken to change the present lens-lantern light to a converted flashing fourth-order lens. To support this lantern and lens and to complete the improvement of this station, a new tower is necessary. A dwelling for the assistant keeper should also be provided. Detailed estimate:

75-foot cast-iron tower	$10,000
Erection at site complete	3,600
Dwelling	4,000
Contingencies	1,400
Total	19,000

No. 49. *Goat Island, Cal., lighthouse depot.*—For repairs and improvements to Goat Island lighthouse depot, near San Francisco, Cal., $51,000.

NOTE.—This depot occupies a small area gained by cutting down the steep bluff at the southeast point of Goat Island in San Francisco Bay and filling in along the shore line with the material thus secured. This area and that afforded by the present wharf is now inadequate to afford a proper disposition of the property required to be stored there. This is the only depot in the district. An additional area should be filled in with excavated material to afford room for new storehouses and additional room for storing buoys. The present storehouses are merely wooden sheds, old and poorly constructed. The present wharf should be extended to afford room for working two tenders alongside at the same time, and to permit landing and loading supplies without having to shift material already stored on the wharf. The quarters provided for the depot force are old and insanitary in arrangement and location. New quarters for the keeper and assistant keeper of the depot should be provided on higher ground and the site of the present quarters utilized for the needs of the depot proper. Detailed estimate:

Retaining wall and fill	$5,000
Storehouse, reinforced concrete	18,000
Wharf, additional, on iron piles	12,000
Dwellings	16,000
Total	51,000

No. 50. *Santa Barbara, Cal., Light Station.*—For improving Santa Barbara Light Station, Cal., $29,000.

NOTE.—The station is old and the tower is too small to accommodate the revolving lens now installed in it. The tower stands one-eighth of a mile back from the point of the shore line and the light is partly obscured by trees on other properties. A new tower is required to be built farther out on the point. Coasting vessels bound north keep close inshore to avoid the prevailing northwesterly wind and sea, and a fog signal should be established here with quarters for two additional keepers. An improvement has been made in changing the light from fixed to occulting and an increase of intensity. The fog signal, as well as other improvements, and a new light tower, are necessary to render the aids efficient. Detailed estimate:

Tower, lantern, and fog-signal building	$8,000
Fog-signal apparatus	7,000
Additional quarters	7,000
Improvements to present station	4,500
Contingencies	2,500
Total	29,000

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No. 51. *Cape Spencer, Alaska, Light Station.*—For establishing a light and fog-signal station at or near Cape Spencer, Alaska, $100,000.

NOTE.—Cape Spencer is at the entrance to Cross Sound and Icy Strait, through which pass all vessels running from Puget Sound ports to Prince William Sound, Seward, Cook Inlet, and Kodiak, excepting only occasional freighters proceeding by the outside route. With the construction of the proposed Alaskan railroad the traffic by way of Cape Spencer will be materially increased. A small unwatched light is now maintained on the cape, but it is believed that a large watched light and fog signal should be provided, especially for vessels returning from the westward, to be used as a landfall, as it is important that they be given all possible assistance, especially in thick weather. Maritime interests have urged the establishment of this aid. Detailed estimate:

Foundation	$4,000
Buildings and tower	72,000
Illuminating apparatus	9,000
Fog-signal apparatus	6,000
Contingencies	9,000
Total	100,000

No. 52. *Potomac River, Md., aids to navigation.*—For improving the aids to navigation and establishing new aids on the Potomac River, Md., $120,000.

NOTE.—The Potomac River, from Maryland Point to Washington, about 40 nautical miles, is now lighted only by 4 gas buoys, 5 minor lights, and 1 lighthouse. The gas buoys are of low candlepower and are of necessity removed from station for several months in winter on account of ice conditions. The minor lights are all fixed white or red lights of low candlepower, located on wharves or on timber structures, which are liable to destruction by ice in winter. Jones Point Light Station is of little use on account of changes in shore line at this point. It is proposed to establish 8 sets of flashing acetylene range lights and 7 or more flashing acetylene single lights, and to replace 15 of the present spar buoys by tall nun buoys more readily picked up at night. Jones Point Light Station and the 5 minor lights above mentioned may then be discontinued. Detailed estimate:

Purchase of sites for 10 lights	$24,800
Towers for 10 lights on land, including foundation	14,300
Concrete structures for 6 lights on marine sites	28,200
Structures for 7 lights on land	4,900
Illuminating apparatus for 23 lights	32,700
Fifteen tall-type buoys and moorings	5,100
Contingencies	10,000
Total	120,000

No. 53. *Depot for fifth lighthouse district.*—For enlarging and improving the lighthouse depot at Portsmouth, Va., in the fifth lighthouse district, or for establishing a new depot, $275,000.

NOTE.—The present lighthouse depot at Portsmouth, Va., is entirely inadequate to the needs of the fifth district, both in area and in water front. This is the principal depot of the largest lighthouse district and is the headquarters for five tenders and two light vessels during the greater part of the year. The aggregate length of these vessels is over 1,000 feet; the total wharf frontage is only 445 feet, of which over 200 feet is in a narrow slip available for small light-draft vessels only. The operation of tenders is much hampered by this limited frontage. The very small area available for buoy storage necessitates much otherwise unnecessary handling of heavy buoys and appendages at large cost of time and money. The available wharf frontage of this depot should be doubled, and the area increased by from 4 to 6 acres. This may be done by purchase of a new and larger site, or by purchase of adjacent property. The present buildings are mainly antiquated wooden structures. They constitute a fire menace and should be replaced by modern fireproof buildings. Detailed estimate:

Purchase of water-front property	$125,000
Construction of wharf	52,125
Filling, grading, and paving	42,000
Storehouse, coal shed, repair shop, and keepers' dwelling	37,375
Water mains, fire-protection system, and traveling electric crane	8,500
Contingencies	10,000
Total	275,000

No. 54. *Tender for third lighthouse district.*—For constructing, or purchasing and equipping a lighthouse tender to replace tenders worn out in service in the third lighthouse district, or in the Lighthouse Service generally, $150,000.

NOTE.—There are three tenders in the third district that are old and of obsolete types, and should be replaced as soon as practicable by modern efficient vessels. These are the *Gardenia*, *John Rodgers*, and *Mistletoe*. All of these tenders to be kept in commission require repairs that are not warranted by their age and the service obtained from them. At least one new tender for this district is an urgent present need, and should be followed by other tenders as rapidly as funds become available.

No. 55. *Gas buoys, fifth lighthouse district.*—For the purchase of additional gas buoys for the improvement of aids to navigation in the fifth lighthouse district, $35,000.

NOTE.—A number of deserving projects for the establishment of additional gas buoys should be provided for. Some of these have already received the approval of the Commissioner of Lighthouses, but funds have not been available for their establishment. Detailed estimate:

Thimble Shoal Dredged Channel, Va., 5 buoys	$17,500
Holland Island Bar, Md	2,500
Approach to Beaufort, N. C	3,500
Tail of Horseshoe, Va	3,500
Slue Channel, Thimble Shoal, Va	2,500
Relief buoys	5,000
Contingencies	500
Total	35,000

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No. 56. *Chicago Harbor Light Station, Ill.*—For removing and rebuilding Chicago Harbor Light Station, Ill., and establishing lights on the new breakwater in Chicago Harbor, $142,000.

NOTE.—The present Chicago Harbor Light Station is built on an isolated pier at the southeast end of the existing outer breakwater. The United States engineers are planning the construction of two new breakwaters with a gap between, running south from the existing breakwater, and expect to have the first section of this project completed by December, 1916. This will necessitate the moving of the present Chicago Harbor Light from its present position to the proposed entrance of the outer harbor of Chicago, Ill. It is recommended that a new pier be built just inside the outer end of the breakwater 65 feet by 65 feet and the present cast-iron tower structure, lantern, lens, fog signal boilers, and machinery be taken down and rebuilt in new position; also a new steel fog-signal building, boathouse, and storeroom and power derrick be erected. The light in the new location ought to be put into commission as soon as practicable after the completion of the extension to the breakwater. There will also be needed two acetylene beacons, one at the north end and the other at the south end of the extension of breakwater south of the entrance gap through the breakwater. Detailed estimate:

Steel caisson	$15,519
Water tight plank deck floor to float caisson	3,042
Piling	6,379
Pumping out silt bottom	1,700
Concrete fill	60,000
Concrete pier	13,200
Taking down and rebuilding tower, lantern, lens	5,000
Fog signal building	10,000
Storehouse and boathouse	5,000
Derrick	1,000
Fog signal apparatus	1,200
Outer Breakwater South Light	3,530
Outer Breakwater North Light	3,530
Contingencies	12,900
Total	142,000

No. 57. *Cape Fear Light Station, N. C.*—For the removal of the Cape Fear Light Station, N. C., and appurtenant structures, and rebuilding of the station on the Bald Head Lighthouse Reservation, or other new site, $35,000.

NOTE.—Erosion at Cape Fear Light Station, due to the action of the sea, has been in progress for a number of years, and at the present rate will render the lighthouse and dwellings unsafe in a comparatively short time. On account of the long stretch of shore line it is believed that attempted shore protection would be unduly expensive and probably unsuccessful. It is considered the wisest measure to remove the lighthouse and the keeper's dwellings to Bald Head Lighthouse Reservation or some other site where the light will serve its purpose as a primary seacoast light practically as well as at the present site. Detailed estimate:

Construction of tramway	$7,225
Taking down tower	2,400
Moving and reerection of tower	6,200
Removing and rebuilding three dwellings	12,000
Superintendence	4,000
Contingencies	3,175
Total	35,000

No. 58. *Hilo, Hawaii, aids to navigation.*—For establishing and improving aids to navigation at Hilo, Hawaii, $13,000.

NOTE.—Hilo is the second port of importance in the Hawaiian Islands, and it is probable that the opening of the Panama Canal will greatly increase its shipping. The present lighting is inadequate. It is proposed to establish, (1) an acetylene light in place of the present lens lantern at Alia Point, the entrance to Hilo Bay; (2) an acetylene light on the end of the Hilo Breakwater when completed. Detailed estimate:

Alia Point light	$10,000
Hilo Breakwater light	3,000
Total	13,000

No. 59. *Portage Lake, Mich., aids to navigation.*—For establishing a light and fog-signal station upon a new site and improving aids to navigation at Portage Lake Ship Canals, Mich., $100,000.

NOTE.—The War Department intends to remove the breakwater, and it is therefore necessary to rebuild the light and fog signal on a new site. The new light and fog signal should be established on a pier at the outer entrance, where it would be of the best service to vessels making the harbor. The construction of the station proposed will require considerable time to complete, and this project should have consideration for that reason. Detailed estimate:

Dredging, piling, and cribwork	$15,000
Stone filling and riprap work	10,000
Concrete base with metal flashing	30,000
Superstructure	30,000
Fog signal and lighting equipment	9,000
Contingencies	6,000
Total	100,000

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No. 60. *Ram Island, Me., light.*—For establishing a light on Ram Island, Lower Kennebec River, Me., $3,100.

NOTE.—The need of this light has several times been expressed by petition. Ram Island is about 5½ miles below Bath, Me.; it is a low island in the middle of the river, with a string of half-tide ledges making off on the easterly side. There is a passage on either side, and at some stages of the tide a 5-knot current exists, from which several accidents have occurred. About 300,000 tons of freight and 175,000 passengers are transported past this island annually, not including the many pleasure craft and small boats which frequent the river. It is proposed to establish an acetylene light on or near the easterly side of Ram Island. Detailed estimate:

Light structure, including site	$1,600
Illuminating apparatus	1,300
Contingencies	200
Total	3,100

No. 61. *Cape Kumukahi, Hawaii, Light Station.*—For establishing a light at or near Cape Kumukahi, Hawaii, $22,000.

NOTE.—Cape Kumukahi is the easternmost cape of Hawaii. There is at present no landfall light for vessels bound to Hilo from the Panama Canal or from the southeast. It is a difficult point to round when sailing from Hilo to the south point or vice versa. A light on this point would be a great improvement to the lighting of the islands. The country in this vicinity is barren, undulating lava rock. An acetylene light is recommended with a focal plane height of about 150 feet, which would be visible about 20 miles. Landing from seaward at the cape is impossible at most times, and the only practical method of supplying this station would be by railroad from Hilo to Kapoho and then by wagon road 3 miles to the cape, 1½ miles of which would have to be constructed over the rock. Detailed estimate:

Road	$6,500
Tower, including site and right of way	9,300
Illuminating apparatus	4,000
Contingencies	2,200
Total	22,000

No. 62. *Washington and Oregon, aids to navigation.*—For the establishment of aids to navigation and improvement of existing aids in Washington and Oregon, seventeenth lighthouse district, $35,000.

NOTE.—There has been an increasing demand from shipping interests for additional lighted aids in these waters. It is also desirable to improve a number of existing aids which are now obsolete and unsatisfactory. Gas buoys are desired at Coos Bay, Oreg., Grays Harbor, Willapa Bay, Georgia Strait, and Puget Sound, Wash., and improved lights at a number of places in the lower Columbia River, Wash. and Oreg., and on Clark and Cypress Islands, Wash. Detailed estimate:

7 gas-lighted buoys, at $3,000	$21,000
14 unwatched gas lights, at $1,000	14,000
Total	35,000

No. 63. *Henderson Point, Me., Light Station.*—For establishing a light and fog signal at or near Henderson Point, Piscataqua River, Portsmouth Harbor, Me., $3,800.

NOTE.—The need of this aid has several times been expressed by petition. It is often very difficult to locate Henderson Point at night and in thick weather; the channel is narrow and there is a strong tide at this point, where the course changes. The commercial statistics for Portsmouth Harbor indicate about 5,600 vessels arriving and departing annually, transporting about 610,000 tons of freight. It is proposed to establish an acetylene light with fog bell. Detailed estimate:

Structures, including sites	$1,800
Illuminating and fog-signal apparatus	2,000
Total	3,800

No. 64. *Port Real, P. R., Light Station.*—For establishing a light station at or near Port Real, P. R., $34,000.

NOTE.—The lighthouse at Port Ferro, on the south coast of Vieques or Crab Island, is one of the primary seacoast lights of the Porto Rican system. The light tower and the keepers' dwelling attached to it are built on top of a rocky promontory undermined for some time by the sea, and the whole structure, already dangerously cracked, is in danger of collapsing. It is urgent to rebuild a lighthouse at or near this point, as this is an important aid to the navigation from St. Thomas to Cuba and other West Indian Islands and the Caribbean Sea. A light in this vicinity is necessary for navigation, and it is proposed to dismantle the present Port Ferro Light Station and to erect a new light station at Port Real, about 3 miles westward, where the aid will be more useful and on better ground than on its present location at Port Ferro, as Port Real is the most important and the best anchorage around Vieques Island. The present apparatus at Port Ferro is to be used for this new station. Detailed estimate:

Tower and dwellings for two keepers	$25,000
Outbuilding and piping	1,000
Purchase of site	2,000
Roads and grounds	2,000
Contingencies	4,000
Total	34,000

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No. 65. *Nine Mile Point, Mich., Light Station.*—For establishing a light and fog-signal station at or near Nine Mile Point, Mich., $50,000.

NOTE.—When Forty Mile Point Light Station was established it was placed on the site designated Forty Mile Point on the county-survey charts. Sailing masters expected the station to be placed at Nine Mile Point, near the entrance to the Straits of Mackinac, but which was not so called officially then. While Nine Mile Point is within the visibility of Spectacle Reef and Poe Reef Light Vessel lights, a fog signal would be of especially great service in thick and foggy weather and during seasons when forest fires prevail. Not less than nine strandings occurred here between 1903 and 1909. In the event of establishing this station, Forty Mile Point could be made a minor light. Detailed estimate:

Tower	$15,000
Illuminating apparatus	2,000
Fog-signal building and apparatus	9,000
Dwellings for three keepers	15,000
Outbuildings, boathouse, fences, etc.	6,000
Contingencies	3,000
Total	50,000

No. 66. *Anacapa Island, Cal., Light Station.*—For establishing a light and fog signal at or near Anacapa Island, Cal., $103,000.

NOTE.—Practically all coastwise vessels and a large number of those bound for Panama use the Santa Barbara Channel, and this traffic will be greatly increased with the opening of the Panama Canal. The desirable course leads close to the eastern end of Anacapa Island, which is now marked by a small beacon light, not sufficiently powerful to be of service in hazy weather. The American Shipmasters' Association has presented a petition for a light and fog signal, indorsed by the San Francisco and Los Angeles chambers of commerce and important shipping interests on the Pacific coast. It is therefore recommended that a light of high candlepower and a first-class fog signal be established at this point as soon as practicable. Detailed estimate:

Light tower	$9,000
Illuminating apparatus	8,500
Fog-signal building and apparatus	14,000
Two sets double quarters for four keepers	24,000
Oil house, outbuildings, etc.	6,000
Wharf, launch landing, and derrick	11,000
Roads, grading, and fencing	7,000
Water supply and sewerage system	14,000
Contingencies	9,500
Total	103,000

No. 67. *Caribbean Sea, aids to navigation.*—For establishing aids to navigation in the Caribbean Sea along routes leading to the Panama Canal, $60,000.

NOTE.—The need for aids to navigation in the Caribbean Sea has become more urgent with the increase of traffic due to the Panama Canal, and such aids have been requested by the steamship companies using these routes. It is proposed to establish gas and whistling buoys at Farrall Rock (Gorda Bank), Southwest Cay (Serrana Bank), Formigas Bank, and Blower Rock (Pedro Bank), an unwatched acetylene light on the south end of Old Providence Island, and a first-class can buoy to mark the north end shoal of Old Providence Island. Detailed estimate:

Four gas and whistling buoys with moorings, etc., on station	$36,000
Two gas and whistling buoys with moorings, etc., relief	13,000
One first-class can tall type buoy	1,000
Tower in place	12,500
Illuminating apparatus	4,500
Contingencies	3,000
Total	60,000

Total, group No. 3, $1,999,400 (not included in total of estimates).

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DESCRIPTIONS OF NEW WORKS COMPLETED.

The following are brief technical descriptions of important lighthouse works completed since the end of the fiscal year 1914:

OIL HOUSES FOR LIGHT STATIONS.

Purpose.—Isolated fireproof structures for the storage of kerosene and other inflammable supplies were erected at 7 light stations, in order to lessen the hazard of fire at such stations. These oil houses were constructed under allotments made from the balances existing under appropriations of $10,000 each by the acts of May 27, 1908, March 4, 1909, and June 25, 1910. Details regarding each are shown in the following table:

District.	Station.	Site and structure.	Completed.	Cost.
3d	New Haven, Conn	Two tanks installed	Aug., 1914	$307
	Southwest Ledge, Conn	do	Sept., 1914	438
	Saugerties, N. Y	Brick house 8 by 10 by 7 feet	do	230
	Whale Rock, R. I	One tank installed	do	164
	Stratford Shoal, N. Y	do	Feb., 1915	258
9th	Point Jiguero, P. R	Reinforced concrete throughout	Sept., 1914	292
19th	Honolulu Harbor, Hawaii	do	June, 1915	550

BRANDYWINE SHOAL LIGHT STATION, DEL.

Purpose.—This light station was established in 1851 and the structure had deteriorated to such an extent that it became necessary to rebuild it. The lighthouse was established to mark a dangerous shoal of the same name on the Delaware side of the main ship channel in Delaware Bay. The new station went into commission October 20, 1914.

Site.—The station is located on Brandywine Shoal, easterly side of the main channel. It is placed on a submarine site; the depth of water is 8 feet at mean low water, and the rise and fall of the tide is 6 feet. A boring was made at the site 70 feet below bottom of bay and showed hard compact sand.

Structure.—The foundation of the structure consists of a reinforced concrete pier filled with sand, stone, and concrete, 35 feet in diameter. At the top of this pier is a reinforced concrete deck 46 feet in diameter and 24½ feet above mean low water. The deck supports a three-story dwelling of reinforced concrete, circular in plan, from the roof of which projects a circular watch room, which supports a third-order cylindrical helical-bar lantern whose focal plane is 60 feet above high water. The main deck is covered by a veranda roof and there are galleries with railings on a level with the watch-room floor and lantern floor. The concrete pier was constructed on shore, launched, towed out to the site, and sunk in place on a pile foundation. The pile foundation consists of 74 timber piles driven about 3 feet on center to a penetration of 19 feet. The heads of the piles project 1 foot above the surface of the shoal, upon which the concrete pier rests. In addition to the wooden pile foundation, the lighthouse is also fixed in position and supported by 12 reinforced concrete piles 16 inches in diameter and 34 feet long. These piles were driven into the shoal through annular pockets near the outer circumference of the caisson and the pockets around the piles filled with concrete. A layer of riprap protects the bottom about the structure.

Illuminating apparatus.—The illuminating apparatus consists of a standard third-order lens showing an occulting light having an eclipse of 3 seconds duration every 30 seconds. The occultations are produced by a brass shade falling around the light. This shade is operated by a standard fourth-order clock. The intensity of the light is 12,000 candles, the focal plane is 60 feet above mean high water, and the light is visible 13 miles in clear weather. The light is furnished by a 55 millimeter single-tank incandescent oil-vapor lamp.

Fog signal.—This consists of a third-class Daboll reed box with 3 trumpets pointing in different directions. The compressing outfit consists of a 5-horsepower kerosene oil engine, belt connected to an air compressor arranged to start in 10 minutes.

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Quarters.—There are quarters for three keepers. They consist of a basement containing a large room for the fog signal and several small ones for coal and oil, below which are the cisterns and water tanks. The first floor contains entrance hall, kitchen, and closets; the second floor provides bedrooms and closets; and the third floor bedrooms and closets. Above this is a watch room. Supplies are landed at the station by the tender. There are two landing platforms and ladders and davits for hoisting the keepers' boats.

Cost.—The station was constructed under the act of March 4, 1911, appropriating $75,000. It was constructed under several contracts and completed on November 1, 1914. The total cost was $74,960.34.

AIDS TO NAVIGATION, ALASKA.

Purpose.—During the past year 1 acetylene light, 1 oil light, and 4 beacons were established, structures for 11 lights were erected, ready for the illuminating apparatus, and material is on hand or in transit for 19 others, all of which, it is expected, will be in commission by the fall of 1915. These aids are being established to meet the demands of an increasing commerce and to continue the work of properly lighting and marking these waters. The following is a description of the aids completed and put into commission during the past year:

No.	Name of aid.	Site of locality.	Structure.	Illuminating apparatus.
1	Beacon Point Beacon.	Frederick Sound..	White, slatted tripod; square target.	None.
2	Craig Dolphin.....	San Alberto Bay..	Unpainted pile.....	None.
3	Fish Creek Beacon	Tongass Narrows .	5-pile dolphin; red triangular target.	None.
4	Ratz Harbor Beacon.	Clarence Strait....	White, pyramidal slatted structure; red triangular target.	None.
5	Rugged Island....	Resurrection Bay.	White wooden house supporting a lens lantern 10 feet above ground.	200-millimeter acetylene light, 2 white flashes of 0.3 sec. every 6 sec., of 130 candlepower obscured from 328° to 146°. Focal plane 102 feet above high water; visible 9 miles.
6	South Flat, north end.	Wrangell Strait...	Unpainted pile dolphin; black, square, slatted daymark.	Post lantern oil light fixed white, of 40 candlepower 12 feet above high water.

Dates of establishment and costs of the above aids are as follows: No. 1, September 23, 1914, $48; No. 2, September 25, 1914, $48; No. 3, January 25, 1914, $140; No. 4, August 28, 1914, $58; No. 5, August 9, 1914, $1,195; No. 6, December 1, 1914, $252.

Fog signals.—There are none.

Quarters.—There are no quarters as these lights are of the unwatched type.

Costs.—The total expenditures from the last appropriation of August 1, 1914, amount to $43,073.98, leaving a balance of $16,926.02, of which about $7,000 is obligated.

KEEPER'S DWELLING, BARBERS POINT LIGHT STATION, HAWAII.

Purpose.—Change of characteristic and installation of an incandescent oil-vapor system made it necessary to assign an assistant keeper to this station. For the accommodation of the assistant keeper a small two-room temporary structure was constructed, but this arrangement was not satisfactory or sanitary, in consequence of which the need of a proper dwelling was urgent.

Site.—The new dwelling is located upon the light station reservation about 275 feet north 30° west from the tower. The concrete piers for the footings are laid upon solid coral formation which has an average elevation of 3 feet above high water, the whole forming an excellent foundation.

Structure.—The dwelling is a single frame building of four rooms, bath, pantry, storeroom, and two closets. It has plastered interior, shingled roof, is fitted with complete plumbing and water systems, and is screened on all exterior openings.

Cost.—The building was constructed from an allotment of funds from appropriation "Light keepers' dwellings," provided by act of May 27, 1908. The work was carried out by the purchase of materials and use of hired labor and was completed June 26, 1915. Total amount expended to June 30, 1915, $3,198.96.

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THIMBLE SHOAL LIGHT STATION, VA.

Purpose.—This station was originally built, in 1872, to take the place of the Willoughby Spit Light Vessel and to mark a shoal spot called "The Thimble" which is a great source of danger to vessels navigating the bay and coming in from the sea. The present structure which went into commission December 1, 1914, was built to take the place of the one destroyed by fire in 1909.

Site.—The site is located on the shoalest point of Horseshoe Bar at the entrance to Hampton Roads, Chesapeake Bay, about 3½ miles northeast of Old Point Comfort, Va. Borings made at the site for a depth of 28 feet below the bottom showed hard, fine white sand for the entire depth.

Structure.—The structure consists of a cast-iron pier filled with concrete, 42 feet in diameter at the bottom, reducing upward to 30 feet in diameter at the top of the third course of plates, and curving out into a trumpet-shaped top whose deck is 38 feet 6 inches in diameter and 18 feet 9 inches above mean high water. The deck supports a three-story conical cast-iron dwelling upon the roof of which is a fourth-order cylindrical, helical-bar lantern whose focal plane is 36 feet 6 inches above the main deck. The latter is protected by a railing and covered by a veranda roof whose outer diameter is supported by columns, and there is a second circular railing on the roof of the dwelling. The cast-iron pier was assembled on shore at Berkley, Va., launched by a marine railway, towed out to the site and sunk by the pneumatic process 12 feet 9 inches into the bottom of the bay; 350 tons of the riprap were deposited on the bottom for a distance of 25 to 30 feet out from the caisson, and an additional amount yet remains to be placed.

Illuminating apparatus.—The illuminating apparatus consists of a fourth-order fixed lens of six panels revolving on ball bearings, driven by a standard fourth-order clock and showing a characteristic of fixed white one second, eclipse one second. The occultations are produced by blanketing the alternate panels with spherical mirrors which serve to intensify the light in the opposite panel. The intensity of the light is 46,000 candles, the focal plane is 55 feet 3 inches above mean high water, and the light is visible 13 miles in clear weather. The light is furnished by a 35 millimeter, type B, double tank, incandescent oil-vapor lamp.

Fog signal.—The fog signal consists of a third-class reed horn blown by compressed air. The compressing plant is in duplicate and consists of two 12 horsepower kerosene engines and compressors, direct connected, on the same bed. The characteristic is two seconds blast, four seconds silent interval. There are storage tanks for holding a reserve supply of air for immediate use. There is one vertical mushroom trumpet located above the roof of the lantern.

Quarters.—There are quarters for three keepers. Below the floor of the basement there are two cisterns. The basement contains the engine room, coal and wood rooms, oil vault, provision room, and water-closet. There are two large cargo doors in the basement. The first floor contains the main entrance hall, kitchen, living room, closets and pantry. The second floor contains two bedrooms, a storeroom, and closets. The third floor contains a bedroom and watchroom, both with closets. An inclosed stair cylinder with four flights of stairs extends from the basement floor to that of the lantern. Supplies are landed directly at the station by the tender. There are two landing platforms and ladders, and two sets of davits for hoisting the boats.

Cost.—The station was constructed under the acts of June 25, 1910, and August 26, 1912, appropriating a total of $107,000 for the rebuilding of the light and fog signal at this point. The work was carried out under two contracts and cost $99,952.76. The work was started in December, 1912, and was practically completed December 1, 1914. Some protective riprap work remains to be done.

LIGHTHOUSE TENDER "FERN."

Purpose.—The tender *Fern* was built for general lighthouse service in the inside waters of the sixteenth lighthouse district, southeastern Alaska.

Structure.—This tender is 112 feet overall, with a molded beam of 22 feet, and a displacement of 253 tons when floating at a mean draft of 7 feet 3 inches in salt water. The entire vessel, with the exception of the machinery room casing, is built of wood, fitted with water-tight bulkheads. A derrick mast and boom, complete with steam hoister, are fitted forward of the buoy deck.

Machinery.—The propelling machinery consists of one triple-expansion surface condensing engine of the vertical inverted type, having cylinders 10, 17¼, and 28 inches in diameter by 18-inch stroke, driving a bronze propeller 6 feet 4 inches in diameter

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by 8 feet 3 inches pitch, and supplied with steam under a pressure of 200 pounds by an Almy water-tube boiler using oil as fuel, having 42 square feet of grate surface and 1,790 square feet of heating surface. The tender is fitted throughout with all modern appliances, including steam windlass, sanitary plumbing and fixtures, drainage system, and electric-lighting system.

Quarters.—The complement of the tender is four officers and eight men. The officers' quarters and mess room, also galley, storerooms, and bathrooms are on the main deck, while on the upper deck are the master's quarters and pilot house. On the main deck aft is a stateroom and saloon for the inspector or other official passengers. Quarters for eight men are located forward, entirely above the water line, under the topgallant forecastle deck. Four additional berths are provided, and located on the main deck. The cargo hold is located under the buoy deck and has a capacity of 25 tons.

Cost.—This tender was constructed under the acts of May 27, 1908, and March 4, 1909, appropriating $200,000, amended by act of July 27, 1912, authorizing the use of this amount for the construction of two tenders for general service. The vessel was built under contract at Winslow, Wash., and the cost was $62,100.35. The construction was commenced June 11, 1914, and the vessel completed and placed in commission June 25, 1915. On July 1, 1915, the tender left Seattle, Wash., for her station in Alaska, arriving at Ketchikan, Alaska, July 4, 1915.

LIGHTHOUSE TENDER "LAUREL."

Purpose.—The tender *Laurel* was built for general lighthouse service in the shoal waters of the Chesapeake Bay and tributaries, fifth lighthouse district.

Structure.—This tender is 104 feet 6 inches overall, with a molded beam of 22 feet, and a displacement of 218 tons when floating at a mean draft of 6 feet 1 inch in salt water. It is a single-deck vessel, constructed entirely of wood, with the exception of three steel water-tight bulkheads. A derrick mast and boom, complete with steam hoister, are fitted at the after end of the buoy deck.

Machinery.—The propelling machinery consists of one triple-expansion, inverted, direct-acting engine, having cylinders 8, 13, and 21 inches in diameter by 16-inch stroke, driving a cast-iron propeller 5 feet 8 inches in diameter by 6 feet 3 inches pitch, and supplied with steam under a pressure of 200 pounds per square inch by one Almy water-tube boiler, using coal as fuel, having 30 square feet of grate surface and 950 square feet of heating surface. The tender is fitted throughout with all modern appliances, including sanitary plumbing and fixtures, and drainage system, but has no electric-lighting system.

Quarters.—The complement of the tender is four officers and eight men. The officers' quarters are located on the upper deck aft of the pilot house. The officers' mess room, galley, storerooms, and bathrooms are on the main deck, also a stateroom for the inspector or other official passengers. Quarters for six men are located under the main deck aft. The cargo hold is located under the buoy deck and has a capacity of 15 tons.

Cost.—This tender was constructed under the act of March 4, 1907, appropriating $60,000. The vessel was built under contract at Baltimore, Md., and the cost was $55,522.15. The construction was commenced October 31, 1913, and the vessel completed and placed in commission May 21, 1915, at Baltimore, Md.

LIGHT VESSEL "No. 96."

Purpose.—Light vessel *No. 96* was on April 24, 1915, placed on station at Poe Reef, southern entrance to Straits of Mackinac, Lake Huron, Mich., in the eleventh lighthouse district.

Structure.—The vessel is 101 feet overall, with a molded beam of 23 feet 6 inches, and a displacement of 260 tons when floating at a mean draft of 10 feet 9 inches in fresh water. The entire vessel is built of steel with upper deck throughout of the turtle-deck type. A steel house is located on the upper deck for chart room and pilot house. One steel lantern mast, of diameter sufficient to contain a ladder giving access to the lantern is fitted. Ballasted bilge keels, of the box-section type, for minimizing rolling are fitted.

Illuminating apparatus.—The signal light is housed in a lantern at the head of the steel mast. It consists of an incandescent electric light in a parabolic reflector; the reflector is revolved to show a flash, and the intensity of the light is equal to 1,000 candles. The focal plane is 42 feet above the water.

Fog signal.—This apparatus consists of a 6-inch mechanically operated air siren, connected to high pressure air-storage tanks supplied by two compressor units, each

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unit being a 3-cylinder air compressor driven by internal combustion motor using kerosene as fuel. A submarine bell, actuated by compressed air, is also fitted.

Machinery.—This vessel is nonpropelling, but is fitted with a stern tube to enable the installation of propelling machinery, if desirable at any future time. The vessel is fitted throughout with all modern appliances, including windlass, sanitary plumbing and fixtures, and drainage system, and electric-lighting system using oil-driven generator and storage batteries.

Quarters.—The complement of the vessel is three officers and three men. The officers' and crew's quarters, galley, mess rooms, pantries, bathrooms, lamp room, and other miscellaneous storerooms are located on the main deck.

Painting.—The hull is red with POE in large white letters on each side.

Cost.—This light vessel was constructed under the act of March 4, 1911, appropriating $75,000. The vessel was built under contract at Muskegon, Mich., and the cost was $71,218.73. The construction commenced April 24, 1913, and completed, and the vessel delivered to the Government on October 23, 1914.

LIGHT VESSEL "No. 98."

Purpose.—Light vessel *No. 98* was, on June 12, 1915, placed on station at the entrance to Buffalo Harbor, Lake Erie, N. Y., tenth lighthouse district.

Structure.—The vessel is 101 feet overall, with a molded beam of 23 feet 6 inches, and a displacement of 260 tons when floating at a mean draft of 10 feet 9 inches in fresh water. The entire vessel is built of steel, with upper deck throughout of the turtle-deck type. A steel house is located on the upper deck for chart room and pilot house. One steel lantern mast, of diameter sufficient to contain a ladder giving access to the lantern, is fitted. Ballasted bilge keels, of the box-section type, for minimizing rolling are fitted.

Illuminating apparatus.—The signal light is housed in a lantern at the head of the steel mast. It consists of an incandescent electric light in a parabolic reflector; the reflector is revolved to show a flash, and the intensity of the light is equal to 1,000 candles. The focal plane is 42 feet above the water.

Fog signal.—This apparatus consists of a 6-inch mechanically operated air siren, connected to high pressure air-storage tanks supplied by two compressor units, each unit being a 3-cylinder air compressor driven by internal-combustion motor using kerosene as fuel.

Machinery.—The propelling machinery consists of one 4-cylinder, 100 horsepower Mietz & Weiss kerosene oil engine of the reversible type, having cylinders 10 inches in diameter by 12-inch stroke, making 340 revolutions per minute, driving a propeller 4 feet in diameter by 3 feet 4 inches pitch. The vessel is fitted throughout with all modern appliances, including windlass, sanitary plumbing and fixtures, and drainage system, and electric-lighting system using oil-driven generator and storage batteries.

Quarters.—The complement of the vessel is four officers and two men. The officers' and crew's quarters, galley, mess rooms, pantries, bathrooms, lamp room, and other miscellaneous storerooms are located on the main deck.

Painting.—The hull is red, with BUFFALO in large white letters on each side.

Cost.—This light vessel was constructed under the act of August 26, 1912, appropriating $250,000. The vessel was built under contract at Muskegon, Mich., and the cost was $89,229.33. The construction commenced April 24, 1913, and the vessel was delivered to the Government on May 29, 1915.

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SUMMARY OF IMPORTANT CONSTRUCTION AND REPAIR WORK UNDER GENERAL APPROPRIATIONS, COMPLETED DURING FISCAL YEAR 1915.

Station.	Cost.	Character of work.
FIRST DISTRICT.		
Little Diamond Island Lighthouse Depot, Me.	$4,717	General repairs to wharf, dwellings, storehouse, barn, and outbuildings.
Stockton Harbor Range Lights, Me.	4,877	Establishment of range lights on skeleton steel towers.
SECOND DISTRICT.		
Gallups Island Light and Fog Signal Station, Mass.	1,740	Installation of light and fog signal.
Middle Ledge and Grassy Island Ledge Lights, Mass.	1,928	Installation of acetylene in place of oil lights.
THIRD DISTRICT.		
General Lighthouse Depot, N. Y.	1,030	Installing heating system and repairs to offices.
Shinnecock Bay Light Station, N. Y.	7,332	Improvements to illuminating apparatus.
Stratford Shoal, N. Y.	5,467	Installation of new fog-signal plant and alterations to station.
Watch Hill Light Station, R. I.	3,336	Concrete shore protection.
FOURTH DISTRICT.		
Cape Henlopen Light Station, Del.	3,816	Timber groynes and bulkhead for shore protection.
Salem River Rear Range Light	1,338	Mast and acetylene lantern established.
Brandywine Shoal Light Station, Del.	8,901	Riprap deposited around station to prevent scour.
Chester Range Lights, Del.	1,243	Establishing range lights.
Listons Range Front Light, Del.	2,284	Riprap, groyne, and sea wall for shore protection.
FIFTH DISTRICT.		
Point Lookout Lighthouse Depot, Md.	6,614	Removing old and building new wharf.
Portsmouth Lighthouse Depot, Va.	4,699	Repairs to wharf.
Lazaretto Lighthouse Depot, Md.	3,375	Repairs to wharf and installation of new motor-driven machinery.
SIXTH DISTRICT.		
Georgetown Light Station, S. C.	3,408	Construction of boathouse, storehouse, fence, and minor repairs.
St. Andrew Sound Light, Ga.	3,423	Establishment of acetylene light on concrete pile substructure.
Fort Sumter Range Front Light, S. C.	2,852	Establishment of acetylene light on concrete pile substructure.
Hilton Head Range Front Light, S. C.	1,291	Installation of acetylene light.
Sapelo Light Station, Ga.	2,839	Construction of new boathouse and fence and minor repairs.
Hunting Island Light Station, S. C.	1,081	New cement walks and general repairs to storehouse and dwelling.
St. Simon Light Station, Ga.	1,122	New cement walks and general repairs to tower and dwelling.
SEVENTH DISTRICT.		
Carysfort Reef Light Station, Fla.	1,191	General repairs to tower.
Egmont Key Range Front Light, Fla.	5,233	Establishing an acetylene light on a reinforced concrete pile substructure.
Key West Light Station, Fla.	1,555	Changing illuminant from oil to acetylene and making general repairs.
Mosquito Bank Light, Fla.	1,009	Changing illuminant from oil to acetylene.
North Bank Light, Fla.	4,705	Establishing an acetylene light on a reinforced concrete pile substructure.
EIGHTH DISTRICT.		
Bunch Timber Range, Lower and Upper Pritchard Long Points, Hurricane Crossing Range, Cobbs Point, Boggy Bayou, and Four Mile Point Lights, Fla.	2,078	Establishment of 9 post lantern lights.
Cape San Blas, Fla.	4,508	Shore protection and cofferdam around tower.
Galveston Bar Gas and Whistling Buoy, Tex.	4,850	Establishment of gas and whistling buoy.
Galveston Bay Channel Entrance Range and Galveston Bay Channel Lights Nos. 3A, 2A, and 4A, Tex.	7,531	Establishment of 5 acetylene lens lantern lights.
Long Point Light, La.	1,097	Rebuilding structure.
Mobile Ship Channel Light No. 8C, Ala.	1,625	Establishment of 1 acetylene lens lantern.
Pass Aux Herons Channel Lights Nos. 2, 4, 6, and 8 and Beacons 2, 4, and 6, Ala.	3,916	Establishment of 4 lens lantern lights and 3 day beacons.

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SUMMARY OF IMPORTANT CONSTRUCTION AND REPAIR WORK UNDER GENERAL APPROPRIATIONS, COMPLETED DURING FISCAL YEAR 1915—Continued.

Station.	Cost.	Character of work.
NINTH DISTRICT.		
Puntilla Point, San Juan Depot, P. R.	1,172	Riprap for shore protection.
Catano Range Front Light, P. R.	3,039	Establishment of low-pressure acetylene light and generator house on reinforced concrete pile substructure.
Anegado Shoal Range Front Light, P. R.	2,764	Do.
Anegado Shoal Range Rear Light, P. R.	2,866	Do.
Ponce Harbor Range Front Light, P. R.	2,164	Do.
TENTH DISTRICT.		
Carleton Island Light, N. Y.	3,250	Establishment of acetylene light on steel tower.
Buffalo South Pier, N. Y.	2,467	Establishment of electric light and fog bell on steel tower.
Presque Isle Pierhead, Pa.	1,775	Increasing height of Erie range light No. 2 and general improvements.
Presque Isle, Pa.	5,194	Rebuilding boathouse, reroofing dwelling, and building 7,000 feet of elevated walk.
Conneaut West Breakwater Light, Ohio	1,651	Establishment of acetylene light on steel tower.
Ashtabula West Breakwater Pierhead Light, Ohio.	1,117	Establishment of temporary acetylene light.
Cleveland East Breakwater East End Light, Ohio.	1,692	Establishment of acetylene light on steel tower.
Lorain East Breakwater Pierhead Light, Ohio.	1,095	Repairing steel tower and reestablishment of light.
Sandusky Depot, Ohio	5,877	Rebuilding buoy wharf.
Manhattan Range, Ohio	2,952	Changing illuminant from oil to oil gas.
ELEVENTH DISTRICT.		
Peach Island Range Lights, Mich.	1,262	Changing illuminant from oil to acetylene.
Fort Gratiot Light Station, Mich.	9,423	Shore protection and minor improvements.
Port Austin Reef, Mich	2,079	New concrete dock, windmill, and tank and minor improvements.
Alpena Light Station, Mich.	5,578	Rebuilding crib, replacing frame tower by iron tower, and changing illuminant from oil to electricity.
Detour Light Station, Mich.	3,645	General improvements.
Vidal Shoals Channel Range, Mich.	2,266	Moving rear structure and building new front structure and laying cable to all lights.
Birch Point Range, Mich.	2,800	Moved dwelling over ice from Brush Point, extended sea wall, repaired docks, laid walks, drove well, and other minor improvements.
Stannard Rock Light Station, Mich.	9,500	Building concrete fog-signal house; installing electric fog signal; hoisting engine, boiler, and steam-heating plant; making minor repairs.
Huron Island Light Station, Mich.	2,397	Laying walks, reconstructing tramway, building concrete bridge, and concrete breakwater.
Big Bay Point Light Station, Mich.	1,945	Remodeling old building for keeper's quarters.
Manitou Light Station, Mich.	6,100	Remodeling fog-signal building, replacing steam fog-signal plant by compressed-air plant, rebuilding dock and minor repairs.
Devils Island Light Station, Mich.	2,120	Installing oil-vapor light and strengthening tower.
TWELFTH DISTRICT.		
Calumet Harbor Light Station, Ill.	1,095	Repairing damage done to station by storm.
Chicago Breakwater South Light, Ill.	1,542	Improvement of illuminating apparatus.
Grossepoint Light Station, Ill.	2,679	Encasing brick tower with reinforced concrete.
Manistee Pierhead Light Station, Mich.	2,224	Remodeling fog-signal building and replacing steam boilers with repaired boilers from Waugoshance.
Menominee Pierhead Light Station, Mich.	1,278	Reerecting metal elevated walk taken from Sheboygan North Pierhead.
Muskegon North Pierhead Light, Mich.	1,737	Establishing acetylene light on steel tower.
Saugatuck North Pierhead, Mich.	2,939	Do.
Squaw Point Light Station, Mich.	1,537	Changing illuminant from oil to acetylene.
St. Joseph Pierhead Light Station, Mich.	3,098	Construction of sea wall, filling grounds, and laying concrete walks.
SEVENTEENTH DISTRICT.		
Alki Point Light Station, Wash.	1,245	The stone revetment at this station was strengthened by the placing of 420 tons of stone.
Cape Meares Light Station, Oreg.	3,329	Dwellings were repaired throughout, complete new plumbing put in, new shop and storehouse built, barn repaired, new cement walks laid, and grounds drained.
Heceta Head Light Station, Oreg.	2,575	Dwellings were repaired throughout, complete plumbing put in, new water-supply pipe laid, fences renewed, and road surfaced and ditched.

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SUMMARY OF IMPORTANT CONSTRUCTION AND REPAIR WORK UNDER GENERAL APPROPRIATIONS, COMPLETED DURING FISCAL YEAR 1915—Continued.

Station.	Cost.	Character of work.
SEVENTEENTH DISTRICT—continued.		
North Head Light Station, Wash.	1,395	The oil houses roofs were renewed, roofs of dwellings repaired and exterior walls cemented and painted, and plaster work and inside finish repaired and renewed.
Umpqua River Light Station, Oreg.	4,053	A new water and sewerage system was installed, including pumping plant and storage tank, dwellings repaired and complete plumbing put in, boat house constructed, barn and fences repaired.
Point No Point Light Station, Wash.	1,260	Fourth-order group flashing i. o. v. illuminating apparatus installed.
West Point Light Station, Wash.	2,756	New water and sewerage system put in, dwellings repaired and remodeled, including complete plumbing throughout.
Tongue Point Depot, Oreg.	7,410	Concrete retaining wall rebuilt for a length of about 300 feet and 8,000 cubic yards of fill made; about 800 tons of riprap were placed to protect wall.
EIGHTEENTH DISTRICT.		
Trinidad Head Light Station, Cal.	1,406	Installing a water supply and storage system.
Angel Island, Cal. (Point Blunt Light; Point Stuart Light).	5,343	Installation of electric lights and electric fog signals controlled from Angel Island Station; also enlarging keepers quarters at Angel Island Station.
Point Reyes Light Station, Cal.	6,806	Compressed-air sirens and 15-horsepower gas engines replaced by large type Diaphone and 30-horsepower engines.
Inner Harbor Fog Signal, Los Angeles, Cal.	2,482	Installation of fog bell and electrically-wound striker.
San Louis Obispo Light Station, Cal.	2,933	Steam fog signal replaced by compressed air automatic siren, gas engines, and air compressors.
Point Sur Light Station, Cal.	3,389	Building wharf and tramway.
NINETEENTH DISTRICT.		
Keahole Point, Hawaii.	2,365	Built new 30-foot reinforced concrete tower and changed old lens lantern light to flashing acetylene light.
Barbers Point, Hawaii.	2,299	Installed 3.6 miles of 1¼-inch pipe for sanitary water supply and erected intake and station distribution tanks.
Laupahoehoe Point, Hawaii.	2,070	Built new 30-foot reinforced concrete tower and changed old lens lantern light to flashing acetylene light.
Kawaihae, Hawaii.	2,144	Built new 34-foot reinforced concrete tower and changed old lens lantern light to flashing acetylene light.
Mahukona, Hawaii.	2,060	Built new 20-foot reinforced concrete tower and changed old lens lantern light to flashing acetylene light.
McGregor Point, Hawaii.	2,182	Do.

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REPORT

OF THE

SUPERINTENDENT, U. S. COAST AND GEODETIC SURVEY

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REPORT

OF THE

SUPERINTENDENT, U. S. COAST AND GEODETIC SURVEY

DEPARTMENT OF COMMERCE,
COAST AND GEODETIC SURVEY,
Washington, D. C., October 9, 1915.

SIR: There is submitted herewith the annual report of the United States Coast and Geodetic Survey for the fiscal year ended June 30, 1915.

PART I.

Part I explains the needs of the Bureau by text and illustrations,[a] and is an appeal for greater recognition of its essential requirements. With the increased work in recent years there has been no corresponding increase in the force and equipment, which is a pertinent cause for the backwardness of much of the work.

PART II.

Part II is a detailed statement of the field and office work of the Bureau. It is accompanied by illustrations[a] showing the progress made in the past year, as required by statute.

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[a] These illustrations appear in the pamphlet edition of the Superintendent's report, but are omitted from this volume.

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Part I.—NEEDS OF THE BUREAU.

NEW BUILDING.

It is an old story to again call attention to the inadequate conditions afforded this Bureau in the buildings at present occupied, which cover 70,000 square feet of floor space, distributed in such a manner that labor is difficult and expensive. One of these buildings was originally built for a hotel, and it is cut up into so many small rooms that the partitions take up much space. Because of this, no division can be properly supervised, with the possible exception of the new printing section. The buildings are five and six stories high, respectively, with 16 different levels in one and 11 in the other, and without any suitable elevator. The buildings are improperly lighted, overcrowded, and reported by the Public Health Service as being insanitary. One of the worst features of the present condition is the fact that they are not fireproof, and records that cost millions of dollars and could not be replaced short of the expenditure of other millions of dollars are constantly in danger. To attempt to remodel these present structures would avail nothing, for actual rebuilding is the only means of providing permanent relief. It is an evident fact that the efficiency of the Bureau is daily disturbed by the incommodious office conditions, and by the inconvenience and loss of time involved in communication between widely separated portions of the buildings.

The foregoing statement can not be overemphasized. The further expenditure of money on these old buildings would be an actual waste, for while they can be made to look fairly well, they are far from proving satisfactory.

It is earnestly hoped that in the near future consideration will be given to the urgent necessity for an up-to-date building that will properly accommodate the officers and workrooms of this Bureau.

CONDITION OF HYDROGRAPHY.

The hydrographic survey of the coast, harbors, and approaches constitutes the most important element of the charts, and is the prime factor in promoting the safety of navigation.

With this report are published four maps[a] to illustrate the condition of the hydrographic surveys of the coasts of the United States and Alaska, all on the same scale in order that correct comparisons may be made at a glance. No. 3 shows the Atlantic coast from Maine to Georgia; No. 4, the coast of Florida and the Gulf; No. 5, the Pacific coast of California, Oregon, and Washington; and No. 6, Alaska.

The colors used on the charts to illustrate the surveys have the following signification: Wire-drag surveys completed, solid red; wire-drag surveys required, hachured red; unchangeable areas, no

[a] Maps not printed in this compilation.

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present work required, solid blue; unchangeable areas, additional work required, hachured blue; changeable areas, recent surveys, solid yellow; changeable areas, old surveys, hachured yellow; reconnoissance work or unsurveyed, tinted gray.

The colored areas cover regions with depths less than 100 fathoms on the Atlantic coast and 1,000 fathoms on the Pacific coast, and represent the extent to which our surveys should be prosecuted as vigorously as the facilities will permit.

TWO NEW VESSELS.

In the report of the Secretary of Commerce for the previous fiscal year the condition of some of the vessels of this service was thoroughly described with the result that Congress appropriated enough money to buy, ready built, a vessel for the work on the Atlantic coast to replace the *Endeavor;* and a contract has now been let for the building of another vessel, to be known as the *Surveyor*, to replace the condemned *McArthur*, for the Pacific coast and Alaskan service. This is a move in the right direction, but is far from meeting the present needs of this Bureau.

On the Pacific coast two vessels should be replaced without delay by new ones suitable for work in exposed localities. The *Gedney* has been condemned. The *Patterson*, now 33 years old, is no longer serviceable for the exposed offshore work. In her weakened condition, exposure to a heavy sea might prove very serious. The vessel was lightly built and underpowered, and the fact that in the future her work, even under favorable conditions, must necessarily be confined to protected waters, emphasizes clearly the necessity for a new vessel for work in western Alaska and on the coast of California, Oregon, and Washington. The *Explorer* also shows structural weakness, and extensive repairs are necessary; her future work should be confined absolutely to the protected waters of southeast Alaska.

In view of the unsafe condition of the *McArthur* and *Gedney* and the fact that neither is seaworthy, they have been ordered sold, as their future existence is a menace to human life and their further use would be without the slightest justification. There is urgent work needed off the coasts of Washington, Oregon, and California; also off central and western Alaska and Hawaii; but until the *Surveyor* is in commission and other similar vessels are built we can not hope to accomplish any of this work, as at the present time there is not a vessel in the Pacific coast service sufficiently seaworthy to be exposed to the risk of this work.

The two new vessels recommended would be used in the unsurveyed and exposed offshore work on the coasts of California, Oregon, and Washington, and off the central and western part of Alaska and Hawaii, where they are urgently needed.

LAUNCHES FOR INSHORE WORK AND WIRE DRAG.

In the past, the more or less established custom of the Survey seems to have been to provide an equipment of surveying vessels of a type suitable for all classes of sounding operations without

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definite considerations as to either the character or location of the working grounds. Obviously, an economical and safe surveying vessel properly designed for efficient offshore hydrography should be of an ocean-going type, and consequently of considerable size and expensive to maintain. On the other hand, a vessel properly designed for inshore or inside hydrography might be, and usually should be, for economical reasons, a comparatively small craft. The net result of the previous custom has been that the effort to provide a type of vessel suitable for both classes of operations has had the unfortunate effect of giving the Survey ships which are for the greater part either too large and expensive to maintain for inside or inshore sounding or too small and unsafe for offshore operations.

Our surveying vessels at present in use, while engaged on inshore work, usually anchor in protected waters and the hydrographic surveys are executed by utilizing ship's launches and boats frequently too small for the purpose. On offshore hydrography these same vessels being too small for safe ocean navigation, necessarily are compelled to wait for good weather before going outside to do their work, and for like reasons must seek shelter whenever bad weather threatens.

The *Isis* and *Bache* are performing useful and economical service on the Atlantic coast offshore work, in regions conveniently located to safe harbors. Otherwise, the *Pathfinder*, now in the Philippines, and the new ship, the *Surveyor*, now under construction, are the only vessels of the Coast Survey large and staunch enough for offshore work. None of these vessels is small enough for economical work in sheltered waters.

In the case of the wire-drag operations, neither these ships nor their launches are of suitable size for the work to be performed, and the custom has grown up of hiring or chartering at a comparatively great cost all the large launches employed on this important class of surveying work.

In the future it is proposed to remedy this unsatisfactory and inefficient condition of affairs by providing vessels and launches of such types and sizes as will suit them in each case to the special work they are to perform.

The question of the larger ocean-going vessels is covered more fully under a previous heading, which leaves only the "one-party launches" and "wire-drag launches" for immediate consideration in this section of this report.

A large proportion of the hydrographic work of the Coast Survey is located close to shore or in inside waters. For reasons already indicated, "one-party launches," each with a complement of officers and crew of about 10 men, are more economical for this class of work than the existing semi-ocean-going type which frequently can employ only one or two parties on inside operations, although carrying an ocean-going complement of officers and crew large enough for three or four parties. But in spite of this fact the Coast Survey has only two "one-party" vessels of inferior type (now employed in Alaska) when in reality there should be at least six on the Atlantic and Gulf coasts and an equal number on the Pacific coast and in Alaskan waters.

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The need for resurveys of changeable areas and the outlets of nearly all bays and inlets from Sandy Hook to the Rio Grande, for the completion of the original surveys in places, and for revision of topography due to changes all along the coast, in order to keep the charts up to date, is imperative and these will be prosecuted with greater vigor as funds are available.

It can be stated here that the ever-increasing demands for new hydrographic surveys due to the increased size, draft, and speed of ships of commerce and of war, together with the constant changes along the sandy shores of the Atlantic coast, are already overtaxing the forces and equipment of the Coast Survey. And now that submersible war vessels, with their requirements of fairly accurate knowledge of depths of 100 feet and more, form an essential part of the national defense, the necessity for new surveys and resurveys is more pressing and vital to the best interests of the country.

As stated previously, the wire-drag surveys, which are of recent origin and which are rapidly developing valuable results, are exclusively carried on by the aid of hired or chartered launches. During the current fiscal year four separate wire-drag parties are in operation, two in Alaska and two on the Atlantic coast. The average cost for these wire-drag parties is estimated at about $20,000 each for the six or eight months' season in which they can best perform their work, or a total of $80,000 for their combined operations.

As a matter of fact, the cost of rental of these launches, which are usually poorly designed and equipped for the work to be performed, would pay for them in three or four years if it were possible to purchase them outright; nor does this take into consideration the time lost on account of their unsuitable design. And this latter saving is no small matter, as the cost of each working day of a wire-drag party actually utilized in surveying operations averages from $200 to $300.

Therefore the money which it is hoped will be appropriated for the purchase of launches for inshore work and wire-drag operations would result not only in considerable saving to the Government but would also add to the efficiency and consequently to the quantity of work done.

WIRE-DRAG WORK.

Due to the increase Congress gave us last year we were able to place in the field four parties instead of two. The results prove the wisdom and the necessity of doing this work on a much larger scale.

The use of the wire drag has revolutionized hydrographic surveying. It was, of course, realized long ago that sounding with the lead line, no matter how closely the soundings were spaced, was not an infallible means of detecting submerged rocks and bowlders, and that ledges and shoals of considerable extent are missed by the lead. This fact was emphasized by many disasters to vessels and by the large number of hidden dangers which became known and were shown on the chart only as the result of such disasters.

Certain portions of our coasts constitute a veritable ocean graveyard in which the submerged rocks are the monuments and bear the names of the ships which were wrecked upon them. But it was not

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until the method of dragging was fully developed and systematically applied that it became clearly apparent that a very large number of submerged dangers might exist, even in much-frequented waters, and remain entirely unknown and unsuspected simply because by fortuitous circumstances no vessel of considerable draft ever happened to pass immediately over them. This applies especially to the rock-bound portions of our coasts.

WIRE-DRAG WORK ACCOMPLISHED IN PAST FIVE YEARS.

Fiscal year.	Dragged area.	Shoals examined.[a]
ATLANTIC COAST.	*Square miles.*	
1911	256	685
1912	250	252
1913	169	561
1914	202	731
1915	250	875
PACIFIC COAST.		
1915	214	300

[a] Probably one-half of the shoals examined had less depth than charted.

COST OF WIRE-DRAG WORK PER ACTUAL WORKING DAY.

Locality.	Month.	Year.	Cost per day.
Atlantic coast:			
Portland	June to September	1914	$333
Buzzards Bay	October to November	1914	213
Key West	January to March	1915	293
Boston	May to August	1915	187
Buzzards Bay	June to September	1914	200
Cape Cod Bay	May to August	1915	194
Southeast Alaska	May to August	1915	328
	July to October	1914	413
	May to August	1915	268

The differences in cost in the same locality in the above table are due to two principal causes:

1. The initial cost includes the first cost of the outfit, a part of which is available for subsequent work.

2. Some variation is due to weather conditions which affect the number of days available for work.

INCREASED APPROPRIATION FOR MANNING AND EQUIPPING VESSELS.

The insufficient complement and equipment for our vessels is so evident that at times it seriously disturbs the efficiency of the work. The enlisted men on the Pacific coast (particularly those in the lower grades, such as seamen and firemen) are paid less than in any other service, either governmental or commercial. Union wages for seamen in the coastwise trade, which control the rates paid in the mer-

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chant marine service, are $55 per month and found, with double pay for overtime. The Lighthouse Service pays seamen $50 per month and 45 cents per day for rations, excepting Alaska where it is 60 cents, and in addition furnishes its seamen with oilskins and sea boots. The Coast Guard pays its seamen $44 per month and rations of 48 cents per day. The Coast and Geodetic Survey pays its seamen $40 per month and 45 cents per day for rations. Besides underpaying the men of this service, they are not assured of continuous work throughout the year, as insufficient funds make it necessary to retain only the number needed to carry on part of the work.

Under the present arrangements it is extremely difficult when recruiting in the spring to get even moderately good crews, and it is usually impossible to build up a permanent organization of reliable men experienced in the specialized work which they are called upon to perform, and sufficiently devoted to the service, by reason of permanent association with it, to willingly and without protest perform extremely arduous work, which the exigencies of the service often demand.

For instance, the crews on the Pacific coast are recruited at Seattle at the one time of the year when men of the type we are seeking are in greatest demand by the lumber interests, the canneries, and fishing fleets, which are then getting ready for their summer work. It is not an exaggeration to make the statement that 70 per cent of the men enlisted in this service, especially on the Pacific coast, come to us as a last resort. We are constantly losing time through the lack of men trained in the work of the service. The surveying vessel with all her appurtenances, is an exceedingly complex and complicated affair, and requires a correspondingly large amount of judgment to keep her in condition. Much of this work is of such a character that it can not be undertaken during the working season, and is therefore another reason why trained men should be kept on these vessels the year around.

If the chief of the party, who is the commanding officer of the vessel, is allowed to build up a permanent organization composed of men such as are absolutely needed for the highest standard of efficiency, then in due time he can be relied upon to greatly increase the amount of work turned out by his vessel and to reduce the unit costs.

Following is a table showing the pay of seamen in the Coast and Geodetic Survey, the Lighthouse Service, the Coast Guard, and the merchant marine on both the East and West coasts:

Service.	East coast.		West coast.	
	Pay per month.	Rations per day.	Pay per month.	Rations per day.
Coast and Geodetic Survey	$30.00	$0.45	$40.00	$0.45
Lighthouse Service	35.00	.45	50.00	[a] .45
Coast Guard	36.00	.45-.51	44.40	[b] .48 up.
Merchant marine	35.00	.50	55.00	.45 to .53

[a] Alaska, pay $55, rations 60 cents.

[b] Rations at Juneau 59 cents.

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COMPARISON OF PRESENT MONTHLY RATES OF PAY OF ENLISTED MEN IN COAST AND GEODETIC SURVEY WITH THAT OF THE PAY OF SIMILAR RATINGS IN THE COAST GUARD, BUREAU OF LIGHTHOUSES, AND MERCHANT MARINE.

Rating.	Atlantic Coast.				Pacific Coast.		
	Coast Survey.	Light-house Service.	Coast Guard.	Merchant marine.	Coast Survey.	Light-house Service.	Coast Guard.
Assistant to engineer, second class	$55.00	.....	$75.00-110.00	$75.00-80.00	$75.00	.....	$75.00-110.00
Assistant to engineer, third class	40.00	$50.00	44.40	75.00-80.00	60.00	.....	.....
Boatswain	65.00	.....	75.00-110.00	.....	75.00	.....	75.00-110.00
Boatswain mate, chief	50.00	.....	75.00-110.00	.....	65.00	.....	75.00-110.00
Boatswain mate, first class	40.00	.....	75.00-110.00	.....	55.00	.....	75.00-110.00
Boatswain mate, second class	35.00	.....	75.00-110.00	.....	50.00	.....	75.00-110.00
Coxswain for power launch	35.00	.....	38.40	.....	45.00	.....	46.80
Quartermaster, first class	40.00	45.00	44.40	.....	50.00	$55.00	54.00
Quartermaster, second class	35.00	45.00	40.80	.....	45.00	55.00	50.40
Quartermaster, third class	35.00	45.00	.....	.....	45.00	55.00	.....
Seamen	30.00	45.00	36.00	35.00-40.00	40.00	55.00	44.40
Seamen, ordinary	25.00	.....	28.80	.....	35.00	.....	38.40
Writer, first class	40.00	.....	.....	.....	50.00	.....	.....
Writer, second class	35.00	.....	.....	.....	45.00	.....	.....
Wireless operator, first class	40.00	.....	68.00	.....	65.00	.....	68.00
Wireless operator, second class	40.00	.....	40.00	.....	45.00	.....	50.00
Mess attendant, first class	20.00	30.00	21.60	.....	35.00	.....	.....
Mess attendant, second class	16.00	.....	18.00	.....	30.00	.....	21.60

As with the seamen, it will be noted that the other enlisted men are not paid as much as in other departments of the Government service and in the merchant marine. It would seem only proper that their pay be increased to meet other standards. To do this, however, will require a material increase in the appropriation "For all necessary employees to man and equip the vessels."

GEODESY—MORE FUNDS NEEDED FOR EXTENDING PRIMARY TRIANGULATION AND PRECISE LEVELS IN THE UNITED STATES AND ALASKA.

The question has been asked whether or not the geodetic work of the United States should be done by individual States. This must be answered in the negative, and consideration of the following facts will bear this out:

It is necessary to have primary triangulation and precise leveling in each State for the framework of State and county boundary surveys; for national and local topographic, drainage, irrigation, mineral, and other surveys; and for various engineering operations. The necessity for this primary control we must accept as a fact, in view of the experiences of other nations as well as of our own.

The United States is divided into 48 States, some of which are very limited in area. Each of the long arcs of primary triangulation and each of the lines of precise leveling traverses several States, and it is reasonably certain that it would be difficult to obtain the cooperation of all of the States involved in any one arc or line.

Take, for instance, the transcontinental arc of primary triangulation which passes through 14 States; the Texas-California arc which crosses 4; and the ninety-eighth meridian arc which goes through 6. A similar condition obtains with regard to the long-level lines. But,

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suppose each State were willing to do that part of the primary triangulation and precise leveling within its own area, how then could there be a comprehensive scheme for the whole country? It would be absolutely necessary to have a national geodetic association, with each State represented in it, and with a central bureau to direct its operations. If each State worked independently, there would be little or no agreement with the work in adjoining States, and the gaps and overlaps at the boundaries would be a constant source of trouble to surveyors and map makers. Another annoying feature would be the lack of uniformity in the results of the work, as each State would be free to adopt its own standards of accuracy, if there were no supervising bureau. It would require many decades to complete the work, even if executed by the cooperation of all the States, each covering its own territory, and then a central organization would be necessary to adjust the work of the States, and obtain from it a comprehensive whole.

As a concrete example, let us consider the experience of Australia. For a number of years each State of that country conducted its own geodetic surveys independently of the others, with the final result that, at a conference of the surveyors general, held in 1912 at Melbourne, a resolution was adopted recommending that the principal geodetic control be carried on by the Commonwealth Government.

The striking provisions of this resolution are the following:

1. That a geodetic survey of Australia should be undertaken.
2. That, in order to give effect to the foregoing resolution, this conference respectfully recommends that such survey be undertaken by the Commonwealth Government, and submits in support thereof the following reasons:

* * * * * * *

(*c*) That the system which has hitherto prevailed by which the individual States carried out this work with instruments of varying character has resulted in divergent standards of accuracy, rendering the work, to a great extent, unsatisfactory, and, though much of it is of high grade, portions of it are impossible of reconciliation and coordination with a continental scheme.

(*d*) That the desirableness of this work being undertaken by the Commonwealth Government is evidenced by the fact that the Geodetic Survey of the United States is carried out under the direct control of the Federal Government, and that the South African Geodetic Survey is also under one central control.

During the discussion preceding the adoption of the resolutions Mr. Spowers, surveyor general of Queensland, said:

At the present time there is no trigonometrical vote in Queensland, and only a very small area is covered by the major triangulation which was carried out about 1890. In addition to other reasons we are greatly in need of this survey to assist us in the correct compilation of our maps; much time is now lost and expense incurred in endeavouring to make accurate maps from information that is faulty or altogether wanting. We are in the unenviable position of being about the only civilized nation that has not an accurate trigonometrical survey. The work is rightly one for the Commonwealth Government to undertake.

Mr. Poate, surveyor general of New South Wales, remarked:

The geodetic survey of Australia should be undertaken by one body, and that body should undoubtedly be the Federal Government, in order that one standard of accuracy should be applied to the whole of the work, and that it should be similar in character to the great geodetic surveys of the world. It should be conducted on similar lines to those adopted in the United States Coast Survey, and, taking the coast line first, should be gradually extended inland.

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The only logical conclusion seems to be that our National Government should complete the general program which is being followed by the United States Coast and Geodetic Survey. This plan is, briefly, that the primary triangulation scheme and the precise-level net should be so extended that there will be no place in the United States distant more than about 100 miles from a primary triangulation station and from a precise-level bench mark.

Whether the National or State Government should execute the control work in the intermediate areas is another problem. Many of these areas will lie wholly within single States and, as far as State and local surveys and engineering works are concerned, the States could properly supplement the fundamental schemes. However, it is probable that this can not be done by the States.

To carry on geodetic work requires a corps of highly trained specialists and an expensive instrumental equipment, besides trained experts to compute and adjust the results. The State engineering departments are not at present able to do this class of work. For some time after the main schemes of primary triangulation and precise leveling are completed, the National Government must furnish additional control for the national surveys and engineering. Other control for purely State, county, and city use should probably be done by the National Government, with the local political unit paying all or part of the cost.

Even greater New York was forced to have an officer of the Coast and Geodetic Survey to direct the primary triangulation of its area. The Survey was willing to cooperate in this work, because the results would be of great value in the revision of charts in the vicinity of New York City. The city of Cincinnati requested the Coast and Geodetic Survey to detail one of its officers to direct the primary triangulation and precise leveling of that city, but as it was not practicable for this Survey to permit one of its officers to do this, the city of Cincinnati employed a former officer of the Coast and Geodetic Survey to take charge of the work. Several years ago the city of Memphis requested the Survey to extend a primary triangulation over its area, and during the past winter Richmond, Va., requested the Survey to cooperate with it in making primary triangulation and precise leveling over its area. In the case of Cincinnati, Memphis, and Richmond the problem was not similar to that of New York, as the results would not be of value to the Coast and Geodetic Survey in its charting work. However, in the case of Memphis an arc of primary triangulation was carried to that place from which the city may be triangulated. This arc is in the general scheme which the Survey proposes to extend over the whole country eventually.

Atlanta, Ga., and Lufkin, a town in Texas, have recently requested that precise leveling bench marks be established by the Coast and Geodetic Survey for the basis of city surveys and maps. This the Survey can not do now for lack of funds.

The National Government is spending several millions of dollars annually for surveys and maps of various kinds. The efficiency of this work will be materially aided by having the fundamental control extended rapidly. Accurate surveys and maps are national assets and aid materially in the industrial development of the Nation. Primary triangulation and precise leveling are not of immediate value only, for their monuments and bench marks may be used repeatedly

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for an indefinite time, and in any given area, will probably never have to be duplicated. The National Government can well afford to adopt a plan of carrying the fundamental geodetic control to a rapid completion, as only about $1,250,000 is needed to finish the geodetic work here contemplated. If this work could be done at all by the several States, the field and office work and the overhead charges would no doubt cost several times this amount and the great delays would make the Nation the loser by much more than the cost of the work if it were done by the Federal Government.

Illustrations Nos. 9 and 10[a] show the primary triangulation and precise leveling nets which are being extended by the Survey. The first one, which is the triangulation net, shows the completed work in solid black, the work which has been begun in shading, and the work which should be done in the near future in red. The other illustration, No. 10, shows the precise level net, with the work completed in heavy black lines, and the proposed work in red.

The work shown on these illustrations should be carried to a rapid completion while the primary control in the intermediate areas should be extended as the work is specifically called for.

Considering this important phase of the work of this Bureau, the necessity of having precise levels and primary triangulation extended along the principal rivers in Alaska is most important. This Territory is rapidly developing and it is certain that if primary triangulation and precise leveling can be carried into the interior ahead of the detailed surveys, much money will be saved in consequence.

In addition to the triangulation and leveling in the interior of Alaska there is needed a triangulation across the Alaska Peninsula connecting Cook Inlet and Bristol Bay. There are several datums now in Alaska and it is desirable to have the detached schemes of triangulation connected and all the work placed on one datum.

In this connection it is recommended that a primary triangulation be carried from Dixon Entrance northward to White Pass at the head of Lynn Canal, Alaska, and also that the triangulation of Puget Sound and other waters between Point Roberts and Tacoma be strengthened. These two pieces of work are portions of an arc of primary triangulation which will connect Alaska with the United States. The Canadian Government is now undertaking a primary triangulation to extend from Dixon Entrance southward to Point Roberts. If the United States will extend the triangulation to White Pass, as mentioned above, it is expected that the Canadian Geodetic Survey will then carry the triangulation from that point down the Yukon River to a connection with the one hundred and forty-first meridian triangulation in the vicinity of Eagle City. The desirability of having all of the triangulation of North America on the North American datum is apparent to all who have to use the results of triangulation in surveys and maps.

For the purpose of carrying on the triangulation and leveling in the interior of Alaska, there should be appropriated, specifically for this object, at least $20,000 per annum until the work is completed.

The item of the appropriation bill, "Party expenses, Pacific coast," should be sufficiently large to permit of $10,000 being used on the triangulation along the coast between Dixon Entrance and White

[a] Not printed in this compilation.

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Pass, and between Tacoma and Point Roberts; also for the connection between Cook Inlet and Bristol Bay.

There is also needed triangulation revision along the Atlantic coast of the United States and a slight amount on the Gulf coast. This is needed for two reasons. In the first place, the triangulation there is very old and many of the points have been destroyed by the erosion of the shores and by the work of man. Such points as have been destroyed should, in most cases, be reestablished. In the second place, until recent years, the mark of a triangulation station was not of such a character as to insure permanency. When a concrete mark is used without some tablet or lettering designating the purpose, it is very apt to be destroyed by thoughtless persons who imagine that it is a mark for buried treasure. Many of our important stations have been lost for this reason. At present, practically all of the stations of the Survey are being marked by an inscribed metal disk set into the concrete or solid rock which allays any curiosity the visitor may have in regard to the purpose of the mark. Wherever old stations can be found along the coasts they should be re-marked in a substantial manner and one of the tablets should be set in the concrete or rock. About $7,500, as a minimum, should be available each year for a rather indefinite time for the revision of triangulation on the Atlantic and Gulf coasts. This fund should be provided for in the item of the appropriation bill entitled "Party expenses, Atlantic coast."

The following statements show the amount of precise leveling and primary triangulation needed in the interior of Alaska:

TRIANGULATION NEEDED IN ALASKA.

	Miles.
Norton Sound to Eagle, via Yukon River	750
Yukon River to Kuskokwim Bay	350
Upper part of Kuskokwim River	250
Across Alaskan Peninsula, Cook Inlet to Bristol Bay	120
Susitna River, Cook Inlet to Fairbanks	300
Cordova to Tanana, along Copper and Tanana Rivers	700
From Copper River to one hundred and forty-first meridian	100
Total	2,570

PRECISE LEVELING NEEDED IN ALASKA.

Norton Sound to Eagle, via Yukon River	800
Yukon River to Kuskokwim Bay	400
Upper part of Kuskokwim River	300
Susitna River, Cook Inlet to Fairbanks	325
Cordova to Tanana, along the Copper and Tanana Rivers	750
Copper River to one hundred and forty-first meridian	110
Total	2,685

URGENT NEED OF INCREASE IN OFFICE FORCE.

The mass of material directly affecting our charts has so increased in recent years, with further increases in prospect, that it has not been possible with the present force to handle it so as to place it before the navigator in the shape of new charts or new editions of existing charts with the expedition that its importance demands. The importance of this information will be recognized when it is

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understood that in addition to our own numerous detailed surveys, all the vast river and harbor improvements in tidal waters, all the lights, beacons, and buoys on our coasts, and every report of change in navigable waters has to be handled and shown on the chart.

Corrections to charts were made as follows: From blue-print surveys furnished by Corps of Engineers, United States Army, fiscal year 1910, 193; fiscal year 1915, 524. Changes in aids received from Bureau of Lighthouses, fiscal year 1910, 1,900; fiscal year 1915, 2,500.

With reference to our own surveys, the additional work in the office necessary to complete them is indicated by the fact that during the fiscal year 1915 over two and one-half times the work was spent on their completion as compared with that consumed in 1910.

In addition to taking care of new information, the scheme of making new charts on 1–80,000 scale on the Atlantic and Gulf coasts, and the 1–200,000 scale on the Pacific coast should be prosecuted as rapidly as possible; also the charts of southeast Alaska need reconstructing, as they are based on unadjusted data and their defects are becoming more and more apparent with the establishment of new aids to navigation and new examinations made with the wire drag.

The fact that in 1911 there were made a total of 207,568 impressions, and in 1915 a total of 304,799, in connection with the printing of the charts, or a net increase of nearly 50 per cent, furnishes another argument for a substantial increase in our office force. During the past year and in previous years many of the men in the office connected with the various divisions worked overtime.

The inadequate force in the drawing section and printing office of the chart division, and the computing division, and the insufficient number of clerks and messengers are seriously retarding the progress of the work and making it difficult at times to get out necessary work with any degree of promptness. In fact, it has become almost an accustomed condition to have work accumulate owing to the lack of assistance in getting it out.

The recommendation for a further increase in the drawing section is owing to the fact that the present staff is insufficient to handle the chart material received from all sources. The number of employees should be increased adequately to meet the demands, so that charts containing the latest information may be issued at the earliest possible moment.

There is urgent need of the addition of several computers for the computing, tidal, and terrestrial magnetism divisions. The necessity for this increase in the computing force is to enable those divisions to expedite the reduction and publication of the results of the Survey's operations, and make them available for the use of the public as soon as possible. The present force can do little more than keep up with the current needs of the Survey itself, and can do little toward putting new results in final form for publication.

The computation and adjustment of precise levels and the gravity and astronomic observations are practically up to date, but there are at present in the archives data for about 16,000 triangulation stations ready to be computed, the results of which should be published for the public use. These stations are located along the coasts and in the interior of the United States, Alaska, Porto Rico, and Hawaii. They have controlled the original coast surveys and can be used for

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general public surveys for an indefinitely long time if data concerning them are published and thus made available. These stations were established at an average cost of about $65 each, and it would certainly be good business to make the computations and publish the results at a cost of only about $9 per station. The same thing is true of the tidal and current observations, many hundreds of volumes of which are available and awaiting increased force for their discussion and utilization. It is also apparent that placing the results in print is an insurance against loss by fire. At present such a loss would be complete and incalculable.

The clerical service in the Bureau is conspicuously inadequate. For example, the Superintendent has no clerk or stenographer. In a number of the divisions it is found that work has so accumulated, owing to the fact that there is not sufficient assistance in the way of stenographers, that it seriously disturbs the efficiency. For a number of months it has been necessary for the Superintendent to appeal to the Department for help in order to partially catch up with the work. There is no fact which shows more conclusively the need of more office assistance than the inability to keep up with the general routine, even with much overtime work now performed.

There is urgent need of additional force in the printing section. At the present time most of the men who carry on this work are not paid standard salaries in accordance with those paid for similar work in some other departments of the Government and in commercial houses. With the great increase in the output of charts, the force in the printing section has not increased proportionately, and one of the main reasons for back orders is the fact that facilities are not adequate for turning out the work.

ANNUAL SCALES OF PAY.

	Coast Survey.	Hydrographic Office.	Engraving and Printing.	Norris-Peters.	Geological Survey.
Plate printer	$1,200.00	$1,200.00	[a] $5.44 and $5.76		
Assistant plate printer	1,000.00 900.00	1,000.00 900.00 800.00			
Plate printers' helper		700.00 600.00			
Lithographer	1,800.00	1,800.00			
Assistant lithographer	1,000.00	1,000.00			$1,260.00-$1,680.00
Lithographic pressman	1,200.00	1,400.00		[b] $22.00-$28.00	
Lithographic artist	1,700.00 1,200.00 900.00			[c] .60	2,100.00
Transferrer		1,400.00		[b] 20.00-30.00	1,800.00

[a] Per day. [b] Per week. [c] Per hour.

The messenger service is inadequate, largely owing to the fact that the buildings are unsuited to the Bureau's functions. The necessity of a messenger having to take so many steps in order to perform an errand would not exist in a modern office building. Nevertheless, such is the condition, and until it is remedied several additional messengers are necessary.

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BETTER FACILITIES FOR PRINTING CHARTS.

By far the larger part of the results of our surveys reaches the navigator and engineer in the form of charts. Every effort should be made to have this final product of an excellence commensurate with the large amount of time and money spent in collecting and arranging the material the chart shows in a condensed form. The final stage in producing the chart is its printing, and the best press adapted to the work should be employed in order to maintain this branch of the work at the highest standard, and a sufficient number should be provided to render it possible to meet urgent demands promptly.

Each copy of a chart is run through the press from two to five times, the average being three times. First, for the black plate; second, the buoy plate, by which the buoys are colored; third, the tint plate, by which the land areas are distinctly defined from the water areas; and on certain charts blue and yellow tints are also used.

It is most important for the distinctness of the chart that the colors on the different plates should register or fit exactly in their assigned places. How close this register must be will be understood when it is stated that the outline of the symbol which represents a buoy is only one-twentieth of an inch in width. Within this outline the red color must fit.

Faulty register is produced by the expansion or contraction of the chart paper during the intervals between the printings of the three plates.

To obviate this lack of register and to assure the same conditions for the three runs, the second and third runs should follow the first as closely as possible, all three being completed in one day. With a single press this rapid sequence in printing is impracticable, due to the amount of unproductive work it involves. This consists in the necessary cleaning up of the press after the run of the black plate to prepare it for the red buoy color, and a second clean-up after the run of the buoy plate to prepare the press for the tint color. Each of these clean-ups consumes at least an hour's time of additional unproductive work from this source alone.

It therefore becomes necessary to run a number of different charts through the press for one color before it is changed for another color.

Our press is the flat-bed type, which is being rapidly replaced by the rotary offset press in all large commercial lithographic establishments. The Hydrographic Office, United States Navy, has two of the latest type one-color offset presses which have proved highly satisfactory.

A two-color offset press has now been perfected which can be run with the same force as a single-color press. By means of this type of press the two most important impressions, the black base and the buoy color, could be done at one printing.

The offset press presents three distinct advantages for our chart work. First, sharper prints; second, the rapid drying character of the ink used permits the printing of the various colors in rapid succession; third, a reduction in the cost of paper, by omitting the high-surface finish of the paper required by the present press.

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It is therefore recommended that Congress be asked for one of these modern two-color offset presses.

HEATING AND LIGHTING THE BUILDINGS.

The question of lighting and heating the buildings occupied by this Bureau is of more serious importance than ever before. At the present time they are heated by two antiquated low-pressure boilers, which must either be replaced by two new boilers, at an estimated cost of $2,000, or they must be again ineffectually repaired, at an estimated expense of $1,000. In addition to this, there is expended for coal $1,400 per annum in order to heat the Richards Building, and the Treasury Department expends about $1,000 per annum for coal to heat the Butler Building, two-thirds of which is occupied by this Bureau. In addition to the cost for fuel, the care of the boilers entails a considerable burden during six months of the year. The facilities for handling the coal are most inconvenient, the coal being dumped from the trucks into bins under the parking at the front of the building and then taken in wheelbarrows, in small quantities, to the boilers, which are located almost at the rear of the buildings. This coal must be wheeled in the open, over a tortuous route, where the handler is exposed to the inclemencies of the weather throughout the winter. The coal can not be stored in the immediate vicinity of the boilers because there is not adequate storage room.

At present a branch line from the heating main of the central power and heating plant, from which heat is supplied to the buildings under the supervision of the Superintendent of the Capitol Grounds, runs directly through the buildings occupied by this Bureau.

It is a well-recognized elementary principle among those who have examined the question that economy is effected in heating buildings from a large central plant, rather than from many small plants in various buildings.

It is therefore recommended that authority be requested from Congress to tap this heating main that runs through the Survey's buildings, for the purpose of supplying them with heat, which will allow the fuel-wasting and uneconomical boilers now in use to be discarded and the room they occupy to be utilized for other purposes.

If this permission is given, the annual saving to the Government would be $2,460, in addition to the time and labor required for the care and supervision of the present boilers. This involves the work of three laborers from approximately the first of September to the last of April, the clerical help employed in their supervision, the purchase of coal, disposal of ashes, etc. In addition to this, there would be saved considerable annoyance from smoke and ashes, and by no means of least importance, the danger from fire would be lessened.

Regarding the lighting of these buildings and the furnishing of electric current needed, when the present incumbent assumed the Superintendency of this Bureau he learned that a portion of the electric current was being furnished from the Capitol Building, a practice which was started at the time of the Spanish War, and before the power plant was erected. In addition to approving the continuance of this practice, it is recommended that Congress authorize us to run a wire across the street to connect with a current of

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sufficient voltage to supply the necessary power at a cost very much lower than that charged by the Potomac Power Co.

In view of the foregoing, and the fact that this Bureau is located adjacent to this excellent Government service, which can supply the electric current and heat needed by the Survey at a trifling cost, scarcely appreciable, and in view of the fact that there is consumed $2,400 worth of coal per annum in heating the two buildings, to say nothing of the cost of current, and for other reasons already mentioned, it would seem a wise and economical move if the foregoing request could be carried into effect.

TRANSFER OF NAUTICAL EXPERTS TO STATUTORY POSITIONS.

It is recommended that the coast pilot section be reorganized to the extent of transferring its members from their present designations of nautical experts to those of assistants, of equal grade. This will necessitate an increase in the number of assistants, and a corresponding decrease in the appropriations for offshore soundings, the item from which the salaries are now paid. The change will add to the efficiency of the Survey by rendering the high ability of the nautical experts available for all branches of the work, instead of to the strictly coast-pilot work, which is now the case. These officers are the equals of assistants in the survey in education, efficiency, and results accomplished, and should be placed on an equality with them in the items of assignments and advancement.

Additional reasons advanced for the necessity of this change are homogeneity in the field force of the Survey and the assurance of an ample force to draw from at all times to do coast-pilot work. Further, it gives an opportunity to the younger members of the field force, assigned to the coast-pilot work, to know better the needs of the navigator and the requirements of hydrography as well as other branches of our work.

It will eliminate these lump-sum salaries, which are not in harmony with the present policy of Congress.

INTERCHANGEABLE FEATURE OF APPROPRIATIONS.

It is recommended that authority be given in the appropriation bill for the transfer of at least 10 per cent from one specific item appropriated for field expenses to any other item appropriated under that general head. The advantages of such a provision will be readily seen from the following:

First. It is necessary to submit estimates for the appropriations so long in advance that it is impossible to foresee just what work may become imperative during the year, in addition to the systematic plan of work contemplated. Just now it has become necessary to suspend the regular work on Long Island Sound to take up a piece of work on the Maryland coast, which might have been done by an independent party if the necessary expenses could have been met by a transfer from other appropriations. The necessity for special, unanticipated surveys frequently comes up, and must be met at a loss to the Survey by suspending work in progress.

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Second. Any piece of work is liable to cost more than anticipated and will need to be left incomplete unless there is a way to meet the increased expense; this condition occurs near the end of the fiscal year, after all available funds have been allotted. It would generally be possible to meet such emergencies if a transfer from one or more other items of the appropriation was authorized.

Third. The appropriation can not be used to the best advantage because there is always an uncertainty in the exact cost, and consequently a margin of safety must always be maintained in each item of the appropriation. The expenditures are made by widely scattered parties, often in remote regions such as Alaska and the Philippine Islands, and maintaining a margin of safety frequently means a considerable balance.

SUPPORT OF THE INTERNATIONAL GEODETIC ASSOCIATION.

The question of our remaining a member of the permanent commission of the International Geodetic Association is a serious one. Not that there is any question whether we should be represented, but we have entered into what is in effect a treaty with foreign countries with reference to our membership in this association. Congress for the last two years has failed to appropriate funds for the continuation of this country in the International Geodetic Association, but that does not relieve us from responsibilities. This failure to meet our obligations does not sever our connection with that association.

It is believed that the officers of the association do not feel or take the position, because of our not paying our contribution in 1914 and 1915, due to the negative action of Congress, that this is the settled policy of the nation; and this assumption on the part of its officers is shown by the fact that although the United States did not contribute its portion to the expenses of the association for the year 1914, nevertheless the permanent secretary of the association invited the American representative to vote on the question of whether or not the association should continue the convention for another 10-year period, and whether or not there should be any alteration in this convention which will expire December 31, 1916.

In other words, this country's representative was considered to be a member of the permanent commission of this association, in good standing, though the contribution was still unpaid.

The following letter from the Secretary of State was the authority on which Dr. Tittmann based his reply to the permanent secretary:

[Copy.]

DEPARTMENT OF STATE,
Washington, December 22, 1914.

Hon. WM. C. REDFIELD.
Secretary of Commerce.

MY DEAR MR. SECRETARY: I find that I have not answered your inquiry of November 24. The appropriation asked for as our share of the permanent advisory committee of the International Geodetic Association is so small that I heartily agree with you in the opinion that we should continue our membership and that our representatives should be advised to so vote. I shall be glad to join with you in recommending action to Congress.

Very truly yours,

W. J. BRYAN.

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Dr. Tittmann's reply to the permanent secretary of the International Geodetic Association is as follows:

[Copy.]

WASHINGTON, D. C., *December 28, 1914.*

MY DEAR SIR: Referring to previous correspondence on this subject, I now feel at liberty to state that I am in favor of continuing the International Geodetic Convention without alteration for another period of 10 years.

Wishing you a very happy New Year, I am,

Very truly yours,

O. H. TITTMANN,
Superintendent.

Mr. H. G. VAN DE SANDE BAKHUYZEN,
Perpetual Secretary, International Geodetic Association,
Leyden, Holland.

It is shown by the foregoing correspondence and the following letter that the United States has entered into an agreement with other nations, and that we have obligated ourselves to pay the amount due for the last two years, for which no money has been appropriated by Congress.

The following letter shows that the United States agreed to continue in the International Geodetic Association for a period of 10 years after December 31, 1906:

[Copy.]

EMBASSY OF THE UNITED STATES OF AMERICA,
Berlin, November 9, 1905.

M. No. 8004.

The undersigned, ambassador of the United States of America at Berlin, has the honor to inform Monsieur van de Sande Bakhuyzen, permanent secretary of the International Geodetic Association, that the Government of the United States approves of the proposition to continue for a period of 10 years after the 31st of December, 1906, without modification, the agreement under which the International Geodetic Association is operating and which will expire at that date.

The undersigned ambassador avails himself of this opportunity to express to Monsieur van de Sande Bakhuyzen the assurance of his distinguished consideration.

CHARLEMAGNE TOWER.

MONSIEUR VAN DE SANDE BAKHUYZEN,
Permanent Secretary of the International Geodetic Association,
Observatory of Leyden, Holland.

The agreement referred to in the letter of Mr. Tower will expire at the end of the calendar year 1916.

In view of the above it is believed that the United States is still a member of the International Geodetic Association, and this country should not only be represented by a member of the permanent commission, but sufficient funds should be made available by Congress to meet the contributions covering the past two years as well as for the next fiscal year.

ITEMS FOR URGENT DEFICIENCY BILL.

There are two matters which it is believed need consideration in the urgent deficiency bill.

The question of whether the important international latitude observatory at Ukiah, Cal., should be abandoned is a serious one. The board of directors of the Astronomical Society of the Pacific,

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feeling that the European war might make it necessary for the International Geodetic Association to abandon its work at the variation of latitude observatories, passed the following resolutions at the meeting on November 30, 1914:

Whereas it has come to the attention of this board that the work of the International Latitude Observatories is threatened by the present war in Europe, and that some of the stations may be closed: Be it

Resolved, That it is the sense of the Astronomical Society of the Pacific that the work of these stations is of the greatest importance, and that every effort should be made to continue the stations in this country even though others are necessarily closed;

Resolved, That the president and secretary of this society be authorized and instructed to present the views of this society to the proper authorities of the United States Government and urge upon them the desirability of making some special provision for the maintenance of the stations in this country.

It is recommended that the estimates for the Coast and Geodetic Survey for the year 1917 contain a provision for the expenditure of such funds as may be necessary, up to $2,500, for the maintenance of the observatory at Ukiah, Cal., if the International Geodetic Association is not able to continue this observatory in operation on account of the lack of funds or for any other reason while the European war is going on. It should be understood that after the war is over the association should resume the observations at the Ukiah observatory.

The need of a clerical assistant to act in the capacity of a clerk and stenographer to the Superintendent is a matter that is recommended for immediate consideration. At the present time the Superintendent is greatly handicapped, owing to the fact that he has to call for assistance from those who are rendering customary services to other officials in the same Bureau, and further, owing to the inadequate clerical force, the Department has been appealed to during the last six months, and has, at various times, supplied a stenographer. It is earnestly recommended that a clerk to the Superintendent be provided in the urgent deficiency bill.

SUBOFFICES.

The Coast and Geodetic Survey has suboffices at Manila, Seattle, New York, San Francisco, Galveston, Boston, and New Orleans. The Galveston office was started in May of this year, through the interest of the Chamber of Commerce there, which placed at the disposal of our inspector office room and a clerk, with the understanding that an effort would be made to secure the necessary funds next year to maintain this office.

The Boston and New Orleans offices are conducted in cooperation with the Bureau of Foreign and Domestic Commerce and are in the charge of officers of that Bureau, who have files of our publications and charts for the information of those interested who may call to consult them. The suboffices at San Francisco, New York, and Galveston have only one officer of the Survey at each.

The Seattle suboffice is useful to the Washington office in securing information and otherwise assisting in carrying on the routine business in connection with the surveys of Oregon, Washington, and Alaska. It becomes more evident each year, with the increase of commercial activities along the coast of Alaska, that this suboffice

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can not give adequate attention to such a large territory. Therefore the need of a suboffice at a suitable point in Alaska, such as Juneau, is worthy of consideration.

On the Atlantic coast, in addition to the suboffices now established, a suboffice at Norfolk would be helpful, and its establishment is worth while considering.

These offices are proving very useful to the maritime public and others in their localities by enabling them to obtain information immediately and directly. Owing to the lack of funds, these offices are restricted in their activities almost exclusively to office routine. Funds are needed to provide each of these offices with a clerk in addition to the officer in charge, so that the clerk would keep the office open and enable the officer in charge to inspect the coasts in his district and make reports to the Washington office of any errors in the existing charts, the need for revision surveys, and any information of benefit to the maritime public and of use in keeping our charts revised up to date.

It would be of invaluable assistance to this Bureau in keeping its charts up to date if the coasts could be divided up into inspection districts (like those of the Lighthouse Bureau and Coast Guard) with an officer conveniently located in each whose duty it would be to constantly inspect the coasts in his district and report to the Washington office, with recommendations, any errors, changes, etc., affecting the accuracy of the charts.

PROPOSED PURCHASE OF DUTCH HARBOR, ALEUTIAN ISLANDS, ALASKA, AS A FEDERAL GOVERNMENT BASE.

A serious problem confronts the Government in reference to a supply base in western Alaska for coal, oil, and other ship supplies. At the present time Unalaska is the headquarters of the Coast Guard cutters, and acts as a supply base for Government vessels; but the arrangement is not ideal for several reasons.

First, the harbor is a poor one. The only means of reaching the wharf is through a very narrow and crooked channel, which is dangerous to a vessel of even ordinary size. Second, at this place the Federal Government has paid many thousands of dollars to a private company for coal transported from Australia, Canada, and the United States, besides incurring other annual expenses in payment of various privileges received. As it is necessary for Government vessels to dock at a private wharf and to accept courtesies in connection therewith, it thereby places them more or less under obligation to a private concern. Third, there is a very poor fresh-water supply at Unalaska and the buildings are inadequate.

In view of the fact that commerce has greatly increased in this section of Alaska, it is quite necessary and natural to look for a permanent supply base. Upon investigation it would seem that Dutch Harbor, the abandoned village and home of the North American Commercial Co., is the logical place for the Federal Government to own. The only wireless station in this section is located close to this deserted village, making it easy of communication; the harbor is excellent, there being ample room for sufficient wharves, and there is a liberal fresh-water supply. The buildings of this company are in more than a fair state of preservation, and besides the good buildings,

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there are coal yards with trackage for hauling coal, scales, derrick, and practical storage bins, already built. As has been stated, the entire village is deserted and can be acquired as a whole. Considering all this it is suggested that it would be highly advisable for the Government to negotiate at an early date for the purchase of this settlement.

The Department of Commerce would be greatly helped by having such a permanent Government station in this isolated section of Alaska as many of its bureaus would be benefited. This Bureau is carrying on important work in that region at the present time, and the natural anticipations are that it will do much more each year. It is necessary for the vessels to have a place where they may readily and cheaply secure their coal and other fuel, which has not been the case heretofore; and in addition to this the new vessels of the Coast and Geodetic Survey, which will do much work in this territory, will be oil burners and could be supplied with fuel from Government tanks, and not from those of a privately owned company.

The Bureau of Fisheries, with its great interests, is custodian of the Pribolof Islands; and the fact that its vessels will ply back and forth from these islands to eastern Alaska, as well as to Seattle, will make this point a valuable one from which to replenish her fuel and other supplies.

The Lighthouse Bureau will also be greatly benefited because of its tenders being in that region at intervals while carrying on their specific work.

Another consideration (and one of the most important features) is that the Coast Guard, which has made its headquarters at Unalaska in the past and which has for some time earnestly recommended the purchase of this property, will feel the benefits to a great extent. Thus, it is not only to the Commerce Department that benefit would accrue.

The Government would immediately feel the beneficial results of this purchase. There are thousands of tons of fuel used by all the Government vessels in that section, which, at present, are purchased from private concerns at large figures; while if the Government owned its own supply base, this same fuel could be furnished from Government bins and tanks, brought there from Government-owned mines and oil wells on Government vessels and colliers. In this way the cost of the purchase of this property would soon be realized in the saving on these supplies. It is earnestly hoped that the coming Congress will act favorably on this recommendation.

RETIREMENT.

The question of retirement for civil-service employees has been very justly receiving consideration from all branches of the United States Government. It seems appropriate to invite attention to the subject at this time.

In this Bureau a number of men resign each year and the gravity of these resignations and their effect on the work of the Bureau can not be overestimated. Young men come into the service, remain a few years, and then, just when they have reached a high standard of

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efficiency and have gained familiarity with the details of the highly technical work, they, or many of them, for some reason resign.

The result of these resignations is that some of its best men are leaving the service, whose places must be filled by young and inexperienced officers whose lack of training prevents them from fulfilling the best interests of the service. The condition narrows down to the twofold question, What is wrong with the service under existing conditions, and what can we suggest to remedy the wrong?

The wrong seems to be this: The service offers a future so unattractive that few men, when they learn what is in store for them, have the courage to continue in it. The dangers and hardships endured, the sacrifices made, are out of all proportion to the rewards received. The men must devote the best years of their life to the service in all parts of the United States, Alaska, and the Philippines; must go to sea in small craft and at the risk of storms and of unknown dangers in waters which their own efforts are charting for the first time; must give up the home life which every man sooner or later desires; and must endure hardships and discomforts inseparable from the work of the service.

They received during the period of their greatest efficiency a moderate salary, hardly sufficient to meet present needs. Promotion is slow owing to the the comparatively large numbers in the lower grades. This is a consideration which is costing the Survey many of its best young men. They come into the service knowing little or nothing about its conditions, remain a few years, then resign and enter upon other work in which there is, perhaps, a future, a greater reward, and a more desirable mode of life.

The remedy for these conditions seems to be a higher official standing as derived from commissions similar to those of the Public Health Service, a retirement similar to that given to officers of the Coast Guard or at least a waiting-orders status, which would insure one of a small competency in old age when unfit for field duty. It is believed that the men of this service are entitled to such consideration.

In efficiency the men in this Bureau are second to none in the Federal Government; the work is cited as the standard of accuracy among other scientific institutions in this country and abroad.

In view of the hardships endured and the dangers encountered, proper retirement is justified fully as much to these officers as to those to whom it has already been given. Yet, at present, any officer injured in line of duty receives one month of sick leave and is then dismissed.

If a comparison be permitted between services dissimilar in character, it would appear that the value of the work done by these officers in promoting commerce and safe navigation is not inferior to that rendered by the Army or Navy in upholding our national interests; by the Public Health Service in safeguarding health; or by the Coast Guard in saving life and property.

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Part II.—FIELD AND OFFICE WORK.

GENERAL STATEMENT OF PROGRESS.

OFFICE OF INSPECTOR OF HYDROGRAPHY AND TOPOGRAPHY.

The inspector has supervision over the work of parties on the surveying vessels and other hydrographic and topographic work, including coast-pilot work in the field and office, and is charged with various duties relating to the repair and equipment of the vessels of the Survey.

VESSELS AND PARTIES, ATLANTIC COAST.

The steamer *Bache* was employed during the greater part of the year on offshore hydrography on a part of the coast of South Carolina, Georgia, and Florida. A number of tall signals were erected on shore for use in this work, and special hydrographic signals, constructed on buoys supplied and placed by the Lighthouse Service, were used in locating lines from which the shore signals could not be seen. Extensive repairs were made to the *Bache* during December, January, and February.

The steamer *Endeavor* was continued on the hydrographic resurvey of a part of Delaware Bay entrance until October 2. Shortly afterwards she was inspected by the local steamboat inspectors and a board of survey examined the vessel on November 9; as a result of their reports she was condemned and ordered to be sold. On May 12 the *Endeavor* was sold to the highest bidder for $1,015.

The steamer *Hydrographer* was employed on hydrographic surveys in Long Island Sound between Execution Rocks and Norwalk Islands, including Oyster Bay. Many uncharted shoal spots and rocky patches dangerous to navigation were discovered. A search was made for reported shoals in Pollock Rip Slue. No shoals were discovered, but some of the aids to navigation were found to be out of position. Afterwards the *Hydrographer* was engaged on a general resurvey of Albemarle Sound, N. C., and a hydrographic resurvey in the vicinity of Sandy Hook, N. J.

The steamer *Isis*, then at Tompkinsville, N. Y., was chartered for the use of the Survey on May 2, in order that she might be prepared for surveying work as soon as practicable after July 1, when the appropriation for her purchase by the Government became available. On May 17 the *Isis* was in the reviewing line at the naval parade and on the 19th she sailed for Washington, D. C., arriving on the morning of the 21st. From that date to June 30 the steamer made several trips down the river and bay, and the remainder of the time she was at the Washington Navy Yard, where plans were made for necessary alterations to fit her for surveying work.

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The schooner *Matchless* completed revision work in places on the east shore of Chesapeake Bay, and after undergoing repairs at Baltimore began a general revision of the surveys of Albemarle and Croatan Sounds, N. C. The work in the western end of Albemarle Sound was completed early in May and that in Croatan Sound was begun.

Two wire-drag parties were employed on the Atlantic coast; one in the aproaches to Portland Harbor, Me.; in Buzzards Bay, Mass., in the southern approach to the Cape Cod Canal; in Narragansett Bay, R. I.; in the vicinity of Key West, Fla.; and in the approaches to Boston Harbor, Mass.

The other wire-drag party was employed in Buzzards Bay, Mass., and in Massachusetts and Cape Cod Bays southward from Minots Ledge.

A large number of uncharted rocks and shoals have been found by the wire-drag parties in the regions examined.

Some improvements have been made in the apparatus and methods used in drag work. A publication has been prepared descriptive of the wire-drag work on the Atlantic coast, and a new form has been devised by which the unit cost of drag work in various localities can be accurately determined.

Chart revision work was completed in the Passaic and Hackensack Rivers, N. J., and a resurvey of Arthur Kill was begun.

A revision survey was made of Great South Bay, Long Island, including triangulation, topography, and hydrography. A topographic and hydrographic survey of Jamaica Bay was completed. Signals for hydrographic work were erected between Sea Girt and Little Egg Inlet, N. J. The water front of Philadelphia was revised.

In August, September, and October, 1914, a revision was made at Salem, Mass., of the topographic details on chart 244. Triangulation points were recovered and re-marked and the positions of prominent objects useful as aids to navigation were determined.

The series of current and tidal observations in the Potomac River, undertaken at the request of the Public Health Service with a view to determining the amount of pollution by sewage, etc., was completed in the latter part of the fiscal year.

At the request of the Commissioner of Fisheries of the State of Virginia, a survey was made to determine the position of the low-water mark on the west side of Parramore Island, Va.

Suboffices of the Survey were established at Boston and New Orleans, through the cooperation of the Bureau of Foreign and Domestic Commerce.

For the convenience of the public, a stock of charts and other publications of the Survey are kept for sale at the suboffices and on certain vessels of the Survey, Bureau of Lighthouses, and Bureau of Fisheries.

Field revision for new editions of the Atlantic Coast Pilot volumes was made of Chesapeake Bay, of the inland waters on the coast of New Jersey, of Delaware Bay and River, the Gulf of Mexico from Key West to the Rio Grande, from Point Judith to New York and up the Hudson River, the inside-route along the south shore of Long Island, and of the approaches to the Cape Cod Canal.

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VESSELS AND PARTIES, PACIFIC COAST.

The steamer *Explorer* completed the survey of Knik Arm, Cook Inlet, Alaska, and its approaches. Special hydrographic work was done off the mouth of Woodrow Creek, at the request of the Alaskan Engineering Commission. After completing the survey of Knik Arm, an examination was made of a reported shoal area in Seldovia Bay. The *Explorer* then took up supplemental hydrography in the open area of Prince William Sound north of Montague Island and between Hinchinbrook and Smith Islands, between Perry and Lone Islands, and on the bar between Culross and Esther Islands. At Juneau the automatic tide gauge was overhauled and an examination was made of the edge of the shoal flat off the mouth of Sheep Creek. In March and April wire-drag work was done in Richs Passage, Wash. Work was begun at the entrance of Cook Inlet, Alaska, on June 9.

The steamer *Gedney* was engaged in combined operations in the waters west of Prince of Wales Island. During the season which began in April of the previous fiscal year surveys were made in Klawak Inlet, Tonowek Bay, Trocadero Bay, Meares Passage, and Sukkwan Strait. An improvised wire drag was made use of in several localities. The surveys of the main ship channels on the west side of Prince of Wales Island and of a safe inside channel from Tonowek Bay to Sea Otter Sound were completed, but further examination with the wire drag is needed.

The steamer *McArthur* was engaged at the beginning of the fiscal year in Nichols Passage and Felice Strait, carrying on combined operations which had been commenced in the previous April, and including triangulation, shore-line topography, and hydrography of the islands and passages. The hydrography was carried through Nichols Passage and into the northern part of Felice Strait. A wire drag was used to supplement the soundings in certain localities. A search was made of a shoal reported in Portland Canal, but no evidence of it was found. In March and April the *McArthur* was employed on revision work in Richs Passage, Wash.

After repairs had been completed at Seattle, work was resumed June 1, 1915, in southeast Alaska, in Felice Strait and its approach from Clarence Strait.

The steamer *Patterson* was engaged at the beginning of the fiscal year in general surveys in the Shumagin Islands and on the adjacent mainland of Alaska Peninsula. The triangulation was extended from the Shumagin Islands to the mainland and eastward to Kuiukta Bay, and was expanded in the Shumagin Group to furnish control for the hydrography and topography. The topography was extended in the Shumagins to include Nagai, Unga, Andronica, and Korovin Islands and the Haystacks. A topographic reconnoissance was carried along the main shore in connection with the triangulation. Two harbors were surveyed with the plane table. The hydrography covers nearly the same region as the topography. Two harbors on Nagai Island, the west coast of Popof and Unga Islands, and the approaches to West Nagai and Gorman Straits were surveyed. Sounding lines were run between the Shumagin Islands and Unimak Pass and in the locality of the reported Lenard Rock. A bank off Cape Sarichef was developed and lines of soundings were run be-

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tween Unimak Pass and Goodnews Bay. A hydrographic and topographic reconnoissance was made in connection with the triangulation from the Shumagins to Kuiukta Bay.

In September and October the *Patterson* made a voyage of 1,700 miles to the assistance of the Coast Guard steamer *Tahoma* wrecked on an uncharted reef in the western Aleutian Islands. Twenty-nine of the crew were picked up and brought back to Unalaska, the remainder of the ship's complement having been rescued by another vessel. The courage of the commanding officer in venturing with the *Patterson*, an old and none too seaworthy vessel, to the rescue of the *Tahoma's* crew is worthy of the highest commendation. Only a few months later he lost his life when the steamer *Lusitania* was destroyed. Work in the field was closed October 23.

The *Patterson* was repaired at Seattle and resumed work in the Shumagin Islands on June 21. On the way a sunken rock with 15½ feet of water in Whale Passage, Alaska, was found and located. Work was in progress at the close of the year.

The work of the steamer *Taku* was the topography and hydrography of Passage Canal and Landlocked Bay, and the triangulation of Landlocked and Fidalgo Bays. The hydrography covers the area between the survey of 1912 off Esther and Culross Islands, across the lower part of Port Wells into Passage Canal, and up the canal to a junction with the 1910 work. Field operations were closed September 28. During the winter revision work in the vicinity of Seattle, Wash., was done by the chief of this party.

Work in Prince William Sound was resumed in June in Ports Gravina and Fidalgo, after a new boiler had been installed and repairs made to the *Taku*.

The work assigned to the steamer *Yukon* was to develop a channel from Kuskokwim Bay through the extensive flats to the main river.

The result of the season's work was the discovery and charting of a good channel across the flats into the Kuskokwim River. Sailing directions for entering and full predictions of the time and height of high and low waters for 1915 for the river were prepared. This survey opens up an extensive region in Alaska which previously was almost inaccessible. The survey of the Kuskokwim was resumed in the latter part of June, 1915.

Wire-drag work in Tongass Narrows, Alaska, was begun in July, 1914. For this work a revision of the triangulation was necessary. A small scheme of triangulation was carried from Mary Island to Mountain Point and Pennock Island. The topography located new wharves at Ketchikan and corrected the shore line in Revillagigedo Channel.

The drag work, to an effective depth of 45 feet, included all of Tongass Narrows from Guard Island to Mountain Point, Nichols Passage in the vicinity of Walden Rocks, Port Chester and entrance, and Revillagigedo Channel from Twin Islands to Alava Point, including the passage north of Bold Island and the entrance to Thorne Arm. Field operations were closed October 10.

Wire-drag work was resumed May 12, 1915, in Revillagigedo Channel and was in progress at the close of the fiscal year. The wire-drag work done in May and June, 1915, covers the area in the main channel between Twin Islands and Cape Fox and the entrance to Boca de Quadra. A 10,000-foot drag was successfully used in the open waters.

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In 1914, 21 dangers were reported, 11 of which are of the first importance. In May and June, 1915, several dangerous rocks were discovered and reported.

A second wire-drag party for work in Alaska was organized in April, 1915, and began work on May 19 in Sumner Strait in the latitude of Bluff Island, from which point by June 30 drag work with an effective depth of 50 feet had been carried northward nearly to Point Baker. Drag work was done along the eastern side of the strait out to longitude 133° 43′ and including Calder Rocks, and an area on the west side southeast from Point Amelius. Triangulation and topography were done to locate signals for the drag work and to check the position of Barrier Islands.

The resurvey of Yaquina Bay, Oreg., including triangulation, topography, and hydrography, which was in progress at the beginning of the fiscal year, was completed November 7.

Current observations were begun during the year at San Francisco Light Vessel, Blunts Reef Light Vessel, Columbia River Light Vessel, Umatilla Reef Light Vessel, and Swiftsure Bank Light Vessel.

INSPECTION DUTY.

An officer has continued on duty as inspector for the coasts of California and in charge of the suboffice at the San Francisco customhouse.

Another officer has continued on duty as inspector for the coasts of Washington, Oregon, and Alaska and in charge of the suboffice of the Survey in the Burke Building at Seattle, Wash. He has also been charged with the supervision of the repairs to the vessels of the Survey at Seattle, and with various details of field work.

Three officers of the Survey have been assigned at different times to duty as Assistant Inspector of Hydrography and Topography. Among the duties performed by these officers are the preparation of estimates for future work, the inspection of vessels requiring repairs, and the purchase and preparation of plans for the construction of new vessels.

HAWAIIAN ISLANDS.

In the Hawaiian Islands the revision of the triangulation and topography of the island of Hawaii was resumed in August near Punaluu Harbor and carried northeastward along the coast line to Cape Kunukaki and thence northwestward to Hilo Bay, thus completing the survey of the island on December 31. Numerous points were determined for use in hydrography.

Revision work on the island of Molokai was begun in March and continued until May 31, when work was suspended owing to the exhaustion of the appropriation. The topography was carried from Cape Hawala around the south and west sides of the island nearly to Kalaeokailio.

PHILIPPINE ISLANDS.

The work of the Survey in the Philippine Islands is executed under the direction of the director of surveys, an officer of the Coast and Geodetic Survey, who, acting under authority from the Super-

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intendent, makes plans for the work, issues detailed instructions to the field parties, and also has charge of the suboffice at Manila. The expenses of the work are met partly from the appropriation for the Coast and Geodetic Survey and partly from funds provided by the Philippine Government, which also furnishes four vessels for surveying purposes. One steamer, the *Pathfinder*, is furnished by the Coast and Geodetic Survey.

The five vessels of the Survey have been kept in the field as continuously as possible, the principal cause for delay being the necessity for rather extensive repairs.

In the matter of general expenses the increased cost of coal is adding very materially to the expense of the work. This is especially true in the case of the steamers *Marinduque* and *Romblon*, for the reason that the region in which they are employed, the coast of the Calamian Group and of Palawan Island lies apart from the more frequented routes of travel and commerce, in consequence of which the price of coal at ports in that region is much higher than in the principal commercial ports of the archipelago. The same extra expense applies in a great measure to the steamer *Fathomer*, as that vessel has frequent occasion to coal at Port Uson, in the Calamian Group, and consumes much more coal than the *Marinduque* or the *Romblon*.

The steamer *Pathfinder* was engaged in work as follows: A survey was made on the south coast of Mindanao from Parang across the delta of the Mindanao River and southward to Port Lebak. A junction was completed on the east coast of Mindanao, near Hinatuan, between the surveys previously executed on that coast. A special examination was made of certain parts of the Sulu Sea, including Moyune Shoal and vicinity. A survey was made of a reported shoal on the east coast of Negros. A revision was made of the surveys of the coast south of Manila Bay entrance. A special survey was made of Palmas Island. A hydrographic examination was made in vicinity of San Bernardino Island.

The steamer *Fathomer* was employed chiefly in the development of the region around the Cuyo and the Calamian Groups of islands. A special examination was made of a part of Iloilo Strait in which a sunken rock had been reported, and a large-scale topographic survey of the city of Iloilo was made at the request of the secretary of commerce and police in connection with projected harbor and municipal improvements.

The principal work of this vessel has been the hydrography of the important passages between Mindoro, the Semirara Islands, Panay, and the Quinaluban and Cuyo Groups. This work was nearly completed.

The steamer *Marinduque* was chiefly engaged in surveys on the eastern coast of Palawan in the vicinity of Dumaran Island. The main triangulation scheme of Palawan was extended to the vicinity of latitude 10° north. Some shoal spots in Coron Bay, Calamian Group, were developed. The hydrography of unfinished areas east of Coron Island and in the eastern approach to Coron Passage was completed and surveys northward of Dinaran Island were begun.

The steamer *Romblon* was engaged in detailed topographic and hydrographic surveys of the numerous islands and their surround-

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ing waters lying between the northeastern coast of Palawan and the Calamian Group. The filling of gaps in the work of the *Marinduque* west and southwest of Dumuran Island and of a large gap including Taytay Bay and the region eastward of that bay between work previously done by the *Marinduque* and *Romblon*, respectively, was assigned to this vessel. The survey of Taytay Bay was well advanced by the close of the fiscal year.

The steamer *Research* was engaged in general surveys of Ticao and Masbate Passes, including a base line near Bulan; triangulation, topography, and hydrography of southern Luzon, and Ticao and Masbate Islands; surveys of the region around Ticao Island, Sorsogon Province, including subordinate triangulation between Burias Island and Luzon; topography at the entrance to Sorsogon Bay and westward nearly to Donsol; along the western shore of Ticao Island; and along the northeastern shore of Masbate Island from Black Rock Pass to Masbate Harbor; and hydrography in the passages between Luzon, Ticao, Burias, and Masbate, including large-scale surveys of Masbate and San Miguel Harbors. At the end of the fiscal year work was in progress between Masbate Harbor and Port Barrera.

NEW VESSELS FOR THE SURVEY.

As a result of representations made to Congress at its last session by the President and by the Secretary of Commerce as to the urgent needs of the Survey, an appropriation of $289,000 was made, available July 1, 1915, for two new vessels to replace others worn out in the service and not worth further repairs.

After extensive inquiry and an inspection of many vessels offered for sale, a contract was made by the department on April 26 for the purchase of the steamer *Isis* for a sum slightly less than $60,000. The vessel was chartered by the Survey until the appropriation should become available on July 1. The *Isis* was built in 1902 at a cost of about $225,000 and could not be duplicated for that price at the present time. She is in almost perfect condition in every respect, having been very carefully used, and she is given a very high rating by the American Bureau of Shipping and by the Steamboat-Inspection Service.

The *Isis* is a twin-screw vessel of steel construction, has a double bottom, and was built in 1902. Her length is 180.4 feet, beam 24.8 feet, draft 11.6 feet, depth 13.5 feet, gross tonnage 377, and net tonnage 256. She has twin triple-expansion engines of 2,000 horsepower and double boilers. Her cruising speed on natural draft is 12 knots. Under forced draft she makes from 15 to 17 knots. Her coal consumption at 12 knots is only 9 to 10 tons in 24 hours. In surveying service it is estimated that she will average about 6 tons per day.

The price paid for the vessel included the cost of inspection and classification, cleaning and painting bottom, and other work necessary for putting her in commission.

Immediately after the signing of the contract preparations were begun for manning and equipping the vessel. She was given a position of honor in the review of the North Atlantic Fleet held in New York Harbor May 17. The *Mayflower*, carrying the President, was first in line, next came the *Dolphin* with the Secretary of the Navy

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and guests, and then the *Isis* with the Secretary of Commerce and other officials.

The *Isis* will be employed on offshore hydrographic work along the Atlantic coast. She replaces the old steamer *Endeavor* which was built during the Civil War.

Plans were prepared for a new vessel, authorized in the appropriation act approved March 3, 1915, to be specially fitted and equipped for the exposed offshore work on the coasts of California, Oregon, Washington, western Alaska, and the Aleutian Islands.

SURVEYS REQUESTED.

The following requests for surveys were received during the year, and most of them have been completed or are in progress:

Massachusetts: Survey of Salem Harbor, requested by Salem Chamber of Commerce.

Connecticut: Survey of shoal between Gull Rocks Light and Coasters Harbor Island, requested by Navy Department.

New York: Observations of action of tides and currents on sewage flowing from Paerdegat Basin, requested by the law department of the city of New York.

Virginia: Location of low-water mark on Parramore Island, Va., requested by Bureau of Fisheries. Survey of locality on southern drill ground where U. S. S. *Nebraska* touched, requested by Navy Department.

North Carolina: Determination of positions of aids to navigation in sounds and interior waters, requested by Bureau of Lighthouses.

South Carolina: Examination of locality of wreck of schooner *Frederick W. Day*, requested by Bureau of Lighthouses.

Florida: Continuation of wire-drag work in vicinity of Key West, Fla., requested by Navy Department. Triangulation of St. Vincent Sound, requested by Bureau of Fisheries.

Alabama and Georgia: Precise leveling along the Chattahoochee River, requested by officer in charge, United States Engineer Office, Montgomery, Ala.

Texas: Survey of channel leading seaward from near Sabine Bank Lighthouse, requested by master of steamship *Herman Frasch;* precise level line through Lufkin, requested by city engineer of that place.

Louisiana, Texas, and Canal Zone: Surveys on Gulf coast, coasts of Central America, and approaches to Panama Canal, requested by New Orleans Board of Trade.

Nevada: Line of precise levels from Las Vegas to line between Reno and Hazen, requested by Director of United States Geological Survey.

Ohio: Establishment of meridian line and magnetic station at Portsmouth, Ohio, requested by Board of Trade of Portsmouth.

Alaska: Extension of surveys and wire-drag examinations along the coast in general, requested by Senators and Representatives from the Pacific coast, the Pacific-Alaska Navigation Co., the Alaska Pacific Co., the Alaska Steamship Co., the Governor of Alaska, the Alaska Coast Co., the Humboldt Steamship Co., the Northland Steamship Co., the Pacific Coast Steamship Co., the Seattle Commercial Club, the San Francisco Chamber of Commerce, the masters and

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pilots of steamships *Spokane*, *City of Seattle*, *Northwestern*, *Dolphin*, and *Edith;* survey northward from Dixon Entrance and westward from Icy Straits, requested by master of steamship *Senator;* location and marking of mouth of Kenai River, Cook Inlet, requested by United States Bureau of Fisheries; surveys in Knik Arm, Cook Inlet, requested by Alaskan Engineering Commission, also by commanding officer of U. S. S. *Maryland;* wire-drag survey of Sumner Strait, requested by Pacific Coast Steamship Co.; survey of Felice Strait, vicinity of Duke Island, requested by L. D. Ryus; survey of west coast of Prince of Wales Island, requested by master of steamship *Jefferson* and master of steamship *Santa Ana;* survey of Wrangell Narrows, requested by master of steamship *Admiral Evans;* surveys in southeastern and southwestern portions of coast, requested by pilot of steamship *Seward;* survey of Tongass Narrows and west coast of Prince of Wales Island, requested by master and pilot of steamship *Dolphin;* survey of Tongass Narrows, Snow Pass, and Sumner Strait near Point Baker, requested by master of steamship *Seward;* surveys in Aleutian Islands, requested by the Coast Guard.

Philippine Islands: Survey of Sulu Sea, requested by Philippine Government, communicated by director of coast surveys at Manila.

DANGERS TO NAVIGATION.

Dangers to navigation discovered, investigated, or reported by vessels or parties of the Coast and Geodetic Survey during the year were as follows:

Maine: Shoals and ridges in Portland Harbor and its approaches, discovered and developed with wire drag.

Connecticut: Rock in Pine Island Channel, New London Harbor, Conn., reported.

Rhode Island: Shoals near Newport Harbor, examined.

Massachusetts: Shoal in Pollock Rip Slue struck by steamship *Dimock*, of the Eastern Steamship Corporation, examined; pinnacle rock with 17½ feet of water and numerous shoals and bowlders in Buzzards Bay discovered and located with wire drag.

New York: Eighteen uncharted rocky shoals dangerous to navigation and other rocks and shoals with less depth than charted in Long Island Sound, discovered and located; rock in Hudson River near Peekskill, examined; shoal in East River, on which the steamer *Powhatan* grounded, reported.

Virginia: Reported 27-foot shoal spot in Chesapeake Bay, examined.

Florida: About 100 shoals and coral heads in approaches to Key West, discovered with wire drag and located.

Washington: Rock between Kiket Point and Skagit Island, Wash., reported.

Alaska: Rocks in Passage Canal and pinnacle rock in East Twin Bay, Perry Island, discovered and located; edge of shoal flat off Ship Creek, examined; area of reported shoaling at Seldovia, examined; submerged rock in South Inian Pass, and shoals in channel off Fire Island on which steamer *Alameda* grounded, examined; shoals in western approach to Sukkwan Strait, examined; shoal near

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Craig, Alaska, examined and located; shoals in Kuskokwim River and approaches, located; reef near Attu Island, on which Coast Guard steamer *Tahoma* was wrecked, located; banks, shoals, and pinnacle rocks in the vicinity of Shumagin Islands, examined and located; locality of reported Lenard Rock, reexamined; rock with 14 feet of water near Warburton Island and other rocks in Nichols Passage, Alaska, discovered and located; shoal off Point Davidson, examined and located; rock in entrance to Port Chester and bank off Point McCartney, examined and located; three rocks awash south of Moira Rock and midway between Moira Rock and small island south of same, reported; area of reported danger off River Point, Portland Canal, Alaska, examined; 21 important dangers to navigation and other shoal spots and areas discovered with wire drag in Tongass Narrows, Nichols Passage, Revillagigedo Channel, and Port Chester; bank off Cape Clear, Montague Island, Alaska, reported.

Philippine Islands: Mayune Shoal in Sulu Sea, where British steamship *Bengloe* stranded, examined; 16-foot shoal off east coast of Negros, examined; uncharted shoals northeastward of Palawan Island, discovered and developed; depth over wreck of steamship *Pharsalia*, in entrance to Iloilo Strait, determined; 8-fathom bank in north part of Ticao Pass, discovered and located; locality of reported shoal in approaches to harbor of Iloilo, examined; reef off south side of Jolo Island, reported; rock in Maqueda Channel on which steamer *El Cano* was wrecked, reported; shoal on east edge of Framjee Bank, eastward of Busuanga Island, reported; shoal in 16 feet of water on east coast of Panay on which steamship *Rubi* struck, examined.

ASSISTANCE RENDERED IN SAVING LIFE OR PROPERTY.

In October the Coast and Geodetic Survey steamer *Patterson*, in response to an urgent call by wireless, made a voyage of 1,600 miles to the assistance of the officers and crew of the Coast Guard steamer *Tahoma* wrecked on a reef in the western Aleutian Islands. Three boats' crews of the *Tahoma* were picked up on Attu Island and taken to Unalaska by the *Patterson*, the remainder having been rescued by other vessels. In recognition of the service rendered, the members of the party on the *Patterson* were presented with handsome testimonials by the officers and crew of the *Tahoma*.

The unfortunate loss of this vessel is one of many disasters which emphasize the urgent need of means for the more rapid prosecution of detailed surveys in this dangerous region.

On July 25 assistance was rendered by the steamer *Endeavor*, J. B. Boutelle, commanding, to the lighthouse steamer *Iris*, with the Secretary of Commerce and other officials on board, which had gone aground during a sudden storm at Lewes, Del.

On February 28 the officers and crew of the Survey schooner *Matchless* rendered efficient help in putting out a fire in Edenton, N. C.

At midnight on Saturday June 12 the steamer *Gedney*, F. H. Hardy, commanding, rendered assistance to the fishing schooner *Poloris* by hauling her off Klawak Reef, north end of Fish Egg Island, Alaska, on which she had run aground.

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On the night of July 22 the *Explorer* rendered assistance to the steamer *Bertha*, which was anchored at Ship Creek for use as a floating wharf. In a fresh wind and heavy current the *Bertha* began to drag, and was being carried in toward the beach. Members of the crew of the *Explorer* aided the crew of the *Bertha* in getting up their anchor, which, because of lack of steam, they were obliged to heave up by hand.

On May 25, 1915, in approaching San Bernardino Straits the four-masted schooner *Alpene*, of San Francisco, was sighted by the steamer *Pathfinder* off the north end of Capul Island flying a distress signal. The master of the *Alpene* asked the *Pathfinder* to stand by, as he had lost an anchor and was afraid of being beached by the strong currents. Noting that the vessel was in a helpless condition and fast drifting to the south side of the straits the *Pathfinder* towed the *Alpene* to a safe position at sea.

COAST-PILOT WORK.

The coast-pilot section has been engaged both in field and office work. The field work is mentioned under the heading "Field work, Atlantic coast."

The office work includes the preparation of Coast Pilot, Part IV; the Inside Route Pilot of New Jersey; Coast Pilot Notes for Kuskokwim Bay and River, Alaska; supplements for six coast pilots; and correction sheets for insertion in coast pilots. The preparation of coast-pilot directions for the coast of Alaska from Yakutat Bay westward is nearly completed.

Much valuable work has been done by the coast-pilot section in the examination of original sheets and furnishing data as to the condition of the surveys.

A plan for obtaining, with the cooperation of the Bureau of Lighthouses, slack-water observations in the main channels at the easterly end of Long Island Sound and Cape Cod Canal, to furnish data for current tables to be included in the tide tables, was carried into effect. A general plan was prepared for current observations to be undertaken during the fiscal year 1916.

Special information was compiled from field reports and records of surveys for the use of the Alaskan Engineering Commission.

After obtaining the opinions from mariners and others interested in the charts of the Survey, the use of the foot instead of the fathom as the unit of soundings on charts of 1–80,000 and larger scales of the Atlantic and Gulf coasts of the United States was recommended and adopted.

Certain changes in the form and matter contained in the tide tables published by the Survey were recommended and adopted.

A study has been made of the question of steamship lanes for coastwise vessels.

A number of officers of the Survey with experience on the coast of Alaska were assigned to the coast-pilot section for short periods during the winter and aided in the preparation of notes and sailing directions for that coast.

An Inside Route Pilot of the Gulf Coast of the United States from Key West to New Orleans was compiled by an officer of the Survey detailed for that purpose and has been published.

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TIDES.

Tidal observations were made in connection with all hydrographic surveys in the United States and its outlying territory, and at regular stations at Portland, Me.; Fort Hamilton, N. Y.; Atlantic City, N. J.; Philadelphia, Pa.; Baltimore, Md.; Key West, Fernandina, St. Augustine, and Cedar Keys, Fla.; Galveston, Tex.; San Diego and San Francisco, Cal.; Seattle, Wash.; and Juneau, Alaska. Tidal indicators, exhibiting automatically the stage and height of the tide, were maintained at Fort Hamilton and New York City, N. Y., and Reedy Island, Delaware River.

With the cooperation of the Bureau of Lighthouses, observations of currents were made at a number of light vessels on the Atlantic and Pacific coasts. Similar observations were made when practicable by the hydrographic parties of the Survey.

OFFICE OF INSPECTOR OF GEODETIC WORK.

The duties of inspector are performed at the Coast and Geodetic Survey office and in the field. They consist mainly in planning field work, preparing the necessary instructions for field parties in geodetic work, and correspondence relating to details of field operations; examination of records, computations, and reports; scientific investigations based on the results of the field observations, and computations in the computing division; and preparation for publications of the results of geodetic field and office work.

The inspector and members of the computing division assisted the International Boundary Commissioner by inspecting the records and computations of triangulation and the reports of field parties and aided in certain other details connected with the boundary work.

The most notable events in the geodetic work during the past fiscal year were:

1. The determination of latitude at a large number of stations between central Texas and the Pacific coast and along the California-Nevada boundary. The rapidity with which this work was done was due in a large measure to the use of an autotruck for transportation.
2. The introduction of the autotruck as a means of transportation for parties engaged in reconnoissance and triangulation, which is expected to increase the amount of work accomplished and to decrease its cost.
3. The great rapidity obtained in precise leveling on the line between Butte, Mont., and Pasco, Wash.
4. The completion of the triangulation along the Pacific coast of the Olympic Peninsula, joining the triangulation of Grays Harbor with that of the Strait of Juan de Fuca.

The geodetic work done during the year is as follows:

TRIANGULATION.

The triangulation between Memphis, Tenn., and Huntsville, Ala., begun during the previous fiscal year, was completed. The length of this arc was 190 miles, and 31 stations were occupied in the main scheme in 104 days. Thirty-eight geographic positions were determined and four primary azimuths were observed.

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The erection of signals and marking of stations on the Memphis-Huntsville arc was done by a separate party. Signals were erected at 15 stations. The average height of the tripod on which the instrument rested was 56 feet, and the superstructure on the scaffold on which the observer and the light keeper work was on the average 83 feet in height.

After this work was done a reconnoissance was made for a connection between a detached piece of primary triangulation in the vicinity of Louisville, Ky., and a line of the transcontinental arc in the vicinity of North Vernon, Ind. Signals were then erected and stations marked for this work. In all there were one single and seven double structures and three low stands to support the instrument. The observation of angles in this triangulation were made by a separate party between October 22 and November 19, 1914.

Reconnoissance and preparation of stations for primary triangulation to the northward of Great Salt Lake, Utah, were begun in the latter part of May, 1915, and at the close of the fiscal year the work was in progress. The observation of angles on this triangulation was begun in the latter part of June and was also in progress at the close of the fiscal year. Automobile trucks were used for the transportation both of the reconnoissance and the observing parties. The work to the northward and westward of Utah is being done in response to a request received several years ago from the United States Geological Survey, and will extend into a large area where there is at present no geodetic control based on the North American datum.

The observation of angles on the arc of secondary triangulation which extends from the Strait of Juan de Fuca to Grays Harbor was completed during the year. The reconnoissance for this work and the erection of the signals had been completed during the previous summer. The length of this arc is only 110 miles and there were only 16 stations in the main scheme, but it is probable that no piece of work done on land in the Survey has required greater judgment and skill, as well as ability to face hardships, than this. In much of the area traversed there were no trails and the heavy growth of timber and brush made progress almost as difficult as it is in a tropical jungle. Owing to the character of the country, it was impracticable to clear lines through the timber between stations. It was therefore necessary to elevate the instrument and the heliotropes and lamps above the timber. The lumber used for this purpose was cut in the forest in the vicinity of the stations, and in many cases trees were pulled together to make such supports. A number of the instrument stands were more than 100 feet high. One of them, that at station La Push, was 187 feet above the ground. In one case a tree used to support the lamp and heliotrope was sawed off at a height of 213 feet above the ground. The tower in this case was a single tree, cleared of limbs. It is easily seen that the occupation of these stations at night required steady nerves and great daring.

During the summer of 1914 a triangulation was extended across the Kenai Peninsula, Alaska, between Passage Canal, a branch of Prince William Sound, and Turnagain Arm, a tributary of Cook Inlet. This work was not an extensive one, but there were many difficulties to be overcome, as all of the travel of the party was on

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foot and much of it was over glaciers. Progress was greatly retarded by almost continuous rains.

During the winter and early spring of 1915, 12 high signals were erected on the coast of Georgia and Florida for the use of the steamer *Bache* while engaged in carrying on offshore soundings. These signals were of a special type and served the needs admirably. During the progress of the signal building, beach measurements and tertiary triangulation necessary to determine the geographic positions of the signals were completed. Invar base tapes were used in the beach measurements.

In the latter part of November and December a triangulation was made of St. Vincent Sound, Fla., at the request of the Bureau of Fisheries. The scheme of triangulation was 17 miles in length and 13 stations were occupied. The new work was based upon 4 old stations which had been previously established by the Survey.

During the spring of 1915 a study was made of the commercial lamps which might be used as signal lamps in triangulation. A careful study of the problem and the testing of one apparatus led to the conclusion that no portable lamp could be found that would be more suitable than the one now in use in the Survey. It is very desirable to secure a portable lamp which will have a candlepower much higher than the lamp now in use. Further study is being made of this problem and it is possible that an electric or other kind of lamp may be designed which will meet the needs of the Survey. With a powerful light the time of occupying a station would be materially reduced. A slight haze will make the present lamps invisible or too faint for observing over the longer lines of the triangulation.

PRECISE LEVELING.

Between July 1 and November 3, precise leveling was done on a line extending from Butte, Mont., to Pasco, Wash., by way of Spokane, and also on a short line from Sand Point, Idaho, to the Canadian boundary. This work had been begun in the spring of the preceding fiscal year. The amount of work done on these lines during the present fiscal year was 399 miles. During both July and October previous monthly records for precise leveling were surpassed. During July, 1914, 120 miles were run, while in October of the same year the progress made was 149 miles. The maximum result for one day was 20.5 miles of single line, run in 7 hours of actual leveling.

In the spring of 1915 a line of precise levels was run from Seattle to Blaine, Wash. This work was done in order to connect at the latter place with the precise leveling bench marks of the Canadian Geodetic Survey. At the end of the fiscal year work had been begun on a line to extend from Huntley, Mont., to some point on the Great Northern Railway in the vicinity of Mondak, Mont. At the latter place a connection will be made with precise leveling bench marks established along the Great Northern Railway in 1914.

At Louisville, Ky., 12 miles of leveling were run to connect triangulation station Lutz with a precise leveling bench mark on the Ohio River, and about 1½ miles of leveling were run to connect triangulation station Louisville North Base with a precise leveling bench mark.

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Between July 1 and October 21, 1914, a line of precise levels was run between Minot, N. Dak., and Devon, Mont. The work on this line was begun in the spring of 1913. At Devon a connection was made with the precise leveling bench marks established at that place during the previous season.

In the spring of 1915 precise leveling was done along a line which will extend from Carson City to Las Vegas, Nev. This work was undertaken at the request of the United States Geological Survey for the purpose of furnishing accurate elevations within the area traversed. A number of connections will be made with detached pieces of leveling already done by the Geological Survey. This work was in progress at the end of the fiscal year.

Between October 28 and November 25, 1914, precise leveling was done on a line between Perth Amboy and Sandy Hook, N. J. The line is 29.4 miles in length and it was run for the purpose of testing the stability of a bench mark at Sandy Hook. The work was done in response to a request from the Corps of Engineers United States Army. It was found that the bench mark which had been used as a reference point for the tide gauges for a number of years apparently had sunk 5.3 centimeters (0.17 foot).

The total amount of precise leveling done during the fiscal year was 980 miles.

ASTRONOMIC WORK.

Between July 1 and October 16, 1914, observations were made for the determination of the astronomic latitudes of a number of points along the Texas-California arc of primary triangulation and the oblique boundary between Nevada and California. This work had been begun on May 14, 1914. During the total season 37 stations were occupied, at the rate of 7.4 stations per month. This is a very remarkable rate of progress, considering the difficult character of the country over which the party operated. It was necessary, in most cases, for the members of the party to handpack the instruments and observing tents and other equipment from the autotruck, which was used as a means of transportation, to the stations on the mountain tops. The weather conditions were variable, the temperature ranging from below freezing on the summits of the mountains to as much as 110° in the shade in the valleys. An unusual rate of progress was made during the first 12 days of October, when seven stations were occupied and completed along the Nevada-California boundary. The automobile truck used by this party is the one which had been used the previous season for a party operating between central Colorado and Canada, approximately along the one hundred and fourth meridian. The two seasons' work with the truck proved beyond a doubt that for certain classes of astronomic work it is much more efficient than teams.

Between July 1 and October 28, 1914, a determination was made of the difference of longitude between each two of the three stations, Far Rockaway, Long Island, Naval Observatory, Washington, D. C., and Cambridge, Mass. This work was done as a part of a plan to determine the difference in longitude by cable between Far Rockaway, N. Y., and Borkum, Germany. The Royal Prussian Geodetic In-

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stitute agreed to make the necessary observations at each end of the cable if the Coast and Geodetic Survey would make the observations necessary to connect Far Rockaway with at least two stations of the existing longitude net of the United States. The work of the Coast and Geodetic Survey was completed, but the European war prevented the finishing of the cable work by the observers of the Prussian Geodetic Institute. The longitude work of the Coast and Geodetic Survey observers was done under special instructions which called for the exchange of observers for each difference of longitude, and new transits and chonographs were used for the first time in this Survey. They had been purchased from a firm in Germany for this especial work. They proved very satisfactory and will be used in most of the future determinations of longitude by the Survey.

Upon the completion of the work mentioned above, five differences of longitude were determined between old longitude stations and triangulation stations of the Memphis-Huntsville arc and of the Louisville connection. This work was done between November 1 and January 14.

During the progress of the longitude work, astronomic latitude was observed at five stations.

Azimuths were observed at five triangulation stations of the Memphis-Huntsville arc and the triangulation connecting Louisville with the transcontinental triangulation.

GRAVITY.

During the fiscal year the determination of the intensity of gravity was made at 52 stations in the eastern part of the United States. Western Union Telegraph Co. noon signals were used to rate the chronometers used in this work. This method was substituted for the method by which the time observations were made upon the stars by the gravity observer. Previous to this fiscal year the gravity party consisted of two observers, a station required nine days on an average, and the cost (not including the observers' salaries) was $176. Now only one observer is needed, a station is completed in eight days, and the cost (exclusive of the salary of the observer) is about $57, less than one-third of the former cost. The former high accuracy secured in the results has been maintained since the beginning of the use of the noon signals.

The gravity work has been extended during the year as rapidly as practicable on account of the great value that the results will have for geologists, geophysicists, and others interested in world physics.

OFFICE OF INSPECTOR OF MAGNETIC WORK.

The duties of this office are the planning of magnetic work to be done in the United States and outlying territory under the jurisdiction of the United States; the inspection of magnetic field work on land and at sea and at the magnetic observatories; to recommend the construction or purchase of new magnetic instruments, or alteration of old ones when required, or the designing of new ones; to recom-

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mend changes in the design of magnetic instruments, or methods of observing to secure improved results or to save time; to supervise the planning and construction of magnetic observatory buildings, etc.

The magnetic work accomplished during the year may be summarized as follows:

The magnetic observatories at Cheltenham, Md.; Vieques, P. R.; Tucson, Ariz.; Honolulu, Hawaii; and Sitka, Alaska, were in operation throughout the year. The magnetographs gave continuous records except for occasional brief intervals of a day or less. At Tucson the record of the horizontal intensity variometer was lost for a few days on account of the slipping and final breaking of the quartz fiber suspension. The year as a whole was comparatively free from large magnetic disturbances, but the one on June 17 was the largest recorded since 1909. A seismograph was kept in continuous operation at each observatory, the number of earthquakes recorded being less than in previous years. Meteorological observations were made daily. At Tucson the results were communicated by telephone and telegraph to the Weather Bureau office at Phoenix, Ariz. At Honolulu the results were furnished, as heretofore, to the Honolulu office of the Weather Bureau and to the Ewa Plantation Co.

All of the magnetic instruments used in the field work during the year were standardized at Cheltenham. A new magnetometer of the India Survey type, made for the Survey by Cooke & Sons, of York, England, which was compared at the Kew Observatory before shipment to the United States, was standardized at Cheltenham and its constants determined, thus furnishing a comparison between the Kew and Cheltenham standards. An observer of the department of terrestrial magnetism of the Carnegie Institution of Washington took one of their combined magnetometers and earth inductors to Cheltenham and secured a careful comparison by means of simultaneous observations. Instruments were standardized also for the Navy Department and the Lake Survey.

In May the *Carnegie*, of the above Department, called at Honolulu, and an accurate comparison was made of the magnetic instruments in her outfit with those at the Honolulu observatory.

It became necessary during the year to consider the erection of a suitable building for office and residence purposes at Sitka, and complete plans and specifications for such a building were prepared under the direction of the observer.

MAGNETIC WORK ON LAND.

The magnetic elements, declination, dip, and horizontal intensity, were determined at 416 stations, 71 of which were auxiliary stations observed on account of local magnetic disturbance and 12 were new primary stations to replace old ones which had become unsuitable. The observations were distributed in 31 States.

Eighty-one repeat stations were occupied during the year for the purpose of obtaining data for the determination of the secular change in the magnetic elements, especially the declination. These also are included in the total number of stations given above.

The following tabulation shows the distribution of the stations occupied:

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SUMMARY OF STATIONS.

State.	New stations.	Auxiliary stations.	Repeat stations.	New stations to replace old ones.	Total.
Alabama	13	9	7	.....	29
Arkansas	8	.....	2	.....	10
Florida	7	.....	4	1	12
Georgia	26	4	6	.....	36
Idaho	2	.....	.....	.....	2
Illinois	4	.....	2	.....	6
Indiana	2	.....	1	.....	3
Iowa	14	20	3	.....	37
Kentucky	3	.....	1	.....	4
Louisiana	4	.....	1	.....	5
Maine	1	.....	2	.....	3
Minnesota	23	20	4	.....	47
Mississippi	26	.....	7	1	34
Montana	6	.....	.....	.....	6
Nebraska	.....	.....	1	.....	1
New Hampshire	5	.....	.....	.....	5
New Jersey	11	.....	.....	.....	11
North Carolina	.....	4	2	.....	6
North Dakota	1	2	2	.....	5
Oklahoma	5	.....	2	.....	7
Oregon	.....	.....	1	1	2
Pennsylvania	11	.....	4	.....	15
South Carolina	1	.....	1	.....	2
South Dakota	13	2	3	.....	18
Tennessee	.....	.....	3	2	5
Texas	32	.....	9	4	45
Vermont	5	.....	2	.....	7
Virginia	7	8	4	.....	19
Washington	8	2	3	1	14
West Virginia	6	.....	1	1	8
Wisconsin	8	.....	3	1	12
Total	252	71	81	12	416

There were also 18 stations in Alaska at which declination observations were made by parties engaged in other branches of the field work.

The magnetic work carried on at sea by vessels of the Survey was as heretofore incidental to the regular work and was small in amount, as the ships' routes have covered little new territory.

The plan of magnetic work heretofore adopted has been continued during the year, and the preliminary survey is still in progress. At the close of the fiscal year there were still 331 counties where magnetic stations have not yet been established, and this number will be somewhat increased by the subdivision, especially in the West, of large counties into two or more smaller ones.

The investigation of local disturbance areas is being carried on in connection with the regular magnetic survey. Sixty meridian lines were established during the year. These were all established at the request of local authorities.

APPROPRIATIONS AND DISBURSEMENTS.

The appropriation made by Congress in the sundry civil act for the fiscal year ended June 30, 1915, was $1,039,720, divided as follows:

Field expenses	$320,400
Repairs and maintenance of vessels	40,000
Officers and men, vessels	252,200
Pay of field officers	160,200
Pay of office force	204,420
Office expenses	50,000
Rebuilding lithographic and aluminum printing room	7,500
One-story building	5,000
Total	1,039,720

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The statement of disbursements required by law to be made annually to Congress and published as a separate document gives an account of the names and number of employees of different classes employed on the work, the amount of their salary or compensation, the length of time employed, to whom payments were made under the different items of appropriation and on what account, and the balances remaining of the amounts appropriated for the fiscal year.

For the fiscal year ending June 30, 1916, the items of appropriation are as follows:

Field expenses	$355,400
Repairs and maintenance of vessels	40,000
Officers and men, vessels	252,200
Pay of field officers	174,600
Pay of office force	204,420
Office expenses	50,000
Two new vessels	289,000
Total	1,365,620

PUBLICATIONS.

The following publications were received from the printer during the fiscal year 1915:

Results of magnetic observations made by Coast and Geodetic Survey, (calendar year) 1913 (with observations made in Philippine Islands, calendar year 1912); by R. L. Faris. 52 p., il. 4to. (Special publication 20.) Paper, 10 cents.

Results of magnetic observations made by Coast and Geodetic Survey, (calendar year) 1914; by Daniel L. Hazard. 69 p. 4to. (Special publication 25; serial 3.)

Results of observations made at Coast and Geodetic Survey magnetic observatory near Tucson, Ariz., 1911–12; by Daniel L. Hazard. 104 p., 8 pl., 4to. Paper, 15 cents.

Catalogue of charts, sailing directions, and tide tables of Philippine Islands, 1914. il. 4to. (From Catalogue of charts, coast pilots, and tide tables, 1914, p. 3, 12, 148-191.)

Catalogue of charts, coast pilots, and tide tables, 1914. 230 p., il. 4to.

Description of long-wire drag; by N. H. Heck. Revised edition. 31 p., il., 7 pl. 4to. (Special publication 21.) Paper, 20 cents.

United States coast pilot, Pacific coast: California, Oregon, and Washington (supplement to 2d edition). Oct. 20, 1914. 10 l. 4to.

United States coast pilot: pt. 1, Alaska (supplement to 5th edition). Apr. 16, 1915. 29 l. 8vo. (Serial 8.)

Precise leveling from Brigham, Utah, to San Francisco, Cal.; by William Bowie. 67 p., il. 4to. (Special publication 22.) Paper, 15 cents.

Statement of expenditures in Coast and Geodetic Survey, fiscal year 1914. Dec. 21, 1914. 16 p. 8vo. (H. Doc. 1424, 63d Cong., 3d sess.)

Primary triangulation on one hundred and fourth meridian and on thirty-ninth parallel in Colorado, Utah, and Nevada; by William Bowie. 163 p., 10 pl., 5 maps, 6 p. of maps. 4to. (Special publication 19.) Paper, 25 cents.

Annual report of Superintendent of Coast and Geodetic Survey, fiscal year 1914. 132 p., il., 16 maps. 8vo. (H. Doc. 1391, 63d Cong., 3d sess.) Cloth, 40 cents.

United States Coast and Geodetic Survey, description of its work, methods, and organization. 1915. 56 p., 17 pl., 3 maps. 8vo. (Special publication 23.) (Printed for distribution at Panama-Pacific International Exposition, San Francisco, Cal.) Paper, 10 cents.

United States coast pilot: pts. 1–2, St. Croix River to Cape Ann (supplement to 3d edition). May 5, 1915. 11 l. 8vo. (Serial 10.)

United States coast pilot, Atlantic coast: pt. 3, Cape Ann to Point Judith (supplement to 3d edition). Jan. 20, 1915. 12 l. 8vo.

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United States coast pilot, Atlantic coast: pt. 4, Point Judith to New York. 6th edition; by Herbert C. Graves, assisted by J. T. Watkins. 1915. 259 p., 3 maps. 8vo. Cloth, 50 cents.

United States coast pilot, Atlantic coast: pt. 5, New York to Chesapeake Bay entrance (supplement to 4th edition). Feb. 4, 1915. 14 l. 8vo.

Inside route pilot, Key West to New Orleans, 1914. 96 p., 6 maps in pocket. 8vo. Price, 20 cents.

Triangulation in Alabama and Mississippi; by Walter F. Reynolds. 71 p., 1 pl., 12 p. of diag. (Special publication 24.) 4to. Price, 20 cents.

Coast pilot notes for Kuskokwim Bay and River, Alaska. Mar. 15, 1915. 12 p. 8vo.

Inside route pilot, coast of New Jersey, 1915. 32 p., 3 maps. 8vo. (Serial 4.) Price, 20 cents.

General tide tables for the year 1916 (with list of references). 550 p., il. large 8vo. Price, 50 cents.

Atlantic coast tide tables for eastern North America for the year 1916. (Serial 1.) 184 p., il. large 8vo. (From General tide tables.) Price, 10 cents.

Pacific coast tide tables for western North America, eastern Asia, and many island groups, for the year 1916. (Serial 2.) 178 p. large 8vo. (From General tide tables.) Price, 10 cents.

Tide table for 1915: Kuskokwim Bay and River, Alaska. (Serial 5.) 3 p. large 8vo.

A plane table manual; by D. B. Wainwright. il., 7 litho., 9 pl., 20 p. of pl. (Reprint with corrections, Jan., 1915.) 4to. Price, 50 cents.

The expenditure for printing and binding for the Coast and Geodetic Survey during the fiscal year was $26,345.70.

SPECIAL DUTY.

INTERNATIONAL GEODETIC ASSOCIATION.

The Superintendent continued to supervise the operations of the observatories maintained by the International Geodetic Association at Gaithersburg, Md., and Ukiah, Cal. Observations at Gaithersburg were closed in December, 1914. A report on the results of the observations made with the photographic zenith tube was prepared for publication by Dr. F. E. Ross, the observer in charge. The observations at Ukiah are being continued. No appropriation was made by Congress for the payment of the quota of the United States as an adhering member of the International Geodetic Association for which the United States stands pledged by a joint resolution of Congress. It is hoped that the appropriation of the necessary amount to meet this deficiency will be made. The item for travel of delegates to the meeting of the association was however inserted in the sundry civil act. On account of the European war it is probable that no meeting of the association will be held in 1916.

INTERNATIONAL BOUNDARIES.

UNITED STATES AND CANADA BOUNDARY.

The party engaged in inspecting, determining the positions of monuments, and numbering the monuments on the boundary from the Continental Divide to the Lake of the Woods completed the triangulation over an area of 225 square miles, extending along the boundary for 38.4 miles; determined the positions of 18 monuments, and inspected and numbered 653 monuments, covering 765 miles of boundary line.

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The party engaged in the survey and monumenting of the boundary on Rainy Lake and River measured 17 base lines and completed the triangulation for 37 miles along the boundary, occupied two stations for observations of azimuth, completed 234 square miles of topography (including water areas), surveyed 929 miles of shore line, and located and mapped 767 islands. Two hundred and forty-three reference monuments were set for a distance of 116.5 miles along the boundary. All work on Rainy Lake was completed.

On the section of the boundary between the mouth of Pigeon River and Lake of the Woods 97 square miles of triangulation were completed, 182 geographic positions determined, 58 square miles of topography were completed, and 188 miles of shore line of rivers and lakes surveyed. The triangulation covers Basswood Lake and River and the greater part of Crooked Lake. The topography of Crooked Lake was completed.

The party at work in the northeastern boundary in the valley of Halls Stream completed 14 square miles of triangulation and 20.41 square miles of topography, including 30.5 miles of shore line of creeks and 35.3 miles of roads, and determined 114 geographic positions, besides other incidental work.

The work in this region includes the resurvey and marking of the boundary from the eastern extremity of the section from the Connecticut River to the St. Lawrence River and extending northward along Halls Stream to its junction with the section following the crest of the highlands that separate the drainage of the St. Lawrence River from that of the St. John River.

BOARD ON LIFE-SAVING APPLIANCES.

The former Superintendent continued to act as chairman of the board appointed to examine and report upon life-saving appliances until the date of his resignation in April, 1915.

MISSISSIPPI RIVER COMMISSION.

An officer of the Survey, in addition to other duties, has continued to serve as a member of the Mississippi River Commission.

AMERICAN ASSOCIATION OF MASTERS, MATES, AND PILOTS.

On March 16 an officer of the Survey addressed this association at its convention in Washington, D. C., on the nautical work of the Coast and Geodetic Survey.

The association adopted resolutions asking for the extension offshore of the hydrographic work on the Atlantic coast to the 100-fathom curve, and for close resurveys and examinations with the wire drag in Long Island Sound and elsewhere.

EXHIBIT AT NATIONAL MOTOR-BOAT SHOW, NEW YORK.

An exhibit was made of the charts and publications of the Survey at the National Motor-Boat Show held in Madison Square Garden, New York City, from January 30 to February 6. An officer of the Survey was in charge.

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EXHIBIT AT PANAMA-PACIFIC INTERNATIONAL EXPOSITION, SAN FRANCISCO.

The preparation and care of this exhibit, which consisted of instruments, models, charts, coast pilots, tide tables, and other publications of the Survey, were assigned to an officer of the Survey.

COOPERATION WITH ALASKAN ENGINEERING COMMISSION.

At the request of the Alaskan Engineering Commission, a number of the officers of the Survey furnished to the commission reports relating to certain harbors under consideration for use as railway terminals in Alaska. At the request of the commission the Survey collated all reports received by the commission on this subject. This was in addition to various surveys and examinations made in furtherance of the objects which the commission had in view.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The inspector of geodetic work attended the meeting of the American Association for the Advancement of Science held in Philadelphia December 28 to January 2 and delivered a paper on the subject, "Recent Progress in Precise Leveling."

SURVEY OF GROUNDS OF BUREAU OF STANDARDS.

A topographic survey of the grounds of the Bureau of Standards, supplementing previous surveys, was made at the request of the Director of that bureau.

DETAILS OF FIELD OPERATIONS.

Atlantic Coast.

MAINE, MASSACHUSETTS, AND RHODE ISLAND.

[N. H. Heck.]

Summary of results.—Triangulation: 1 signal pole erected, 1 station in supplemental scheme occupied for horizontal measures. Hydrography: 76 square miles of area dragged, 222.7 miles run while dragging, 11,053 angles measured, 343 soundings made on uncharted shoals, 2 tide stations established, 5 hydrographic sheets finished.

Wire-drag work in progress on July 1 in Casco Bay and approaches to Portland, Me., was continued until September 28. A total area of 76 square miles was dragged, and 343 soundings were taken on uncharted shoals. The number of soundings indicates the nature of the region, which is characterized by narrow rocky ridges running generally from northeast to southwest but without pronounced pinnacles. The area was laid out in sections to facilitate the removal of lobster pots which was necessary before work with the drag could be done. Considering the length of the drag used, the interference with the work from this cause was exceptionally slight.

The area of the Cod Ledges was included in the work instead of the area between the 18 and 25 fathom curves. The former area was badly in need of a drag survey, as vessels of considerable draft, especially large schooners, had been accustomed to cross the ledges at

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various points where the charts indicated ample depth. The usual double purpose of a wire-drag survey, to locate the uncharted shoals and to prove the remaining area free from shoals, was accomplished.

The most notable dangers found were a 29-foot rock in Portland, a 30-foot rock in the channel off Portland Head, extensive shoal areas near Willard Rock, Pine Tree Ledge, and Broad Cove Rock; very shoal extensions of Alden Rock; a shoal with general depths of 29 to 31 feet between Bulwark Shoal and West Cod Ledge Rock, and a long ridge south of West Cod Ledge.

The dragging of this extensive area was a difficult operation, somewhat interfered with by the necessity of keeping out of the danger zones of the heavy-gun target practice of the coast defense forts at Portland during about 20 days in the most favorable part of the season.

The weather was unusually favorable for open sea work. The winds were moderate and the amount of fog below the average.

Improvements.—The automatic winder to guide the wire on the reel so that it would be uniformly wound proved a marked success and made it possible to set out the drag from the guiding launch while proceeding at considerable speed. In this way as much as 4,000 feet of drag was set out in 12 minutes, but such speed can only be used under favorable conditions.

The signaling system operated by compressed air proved a marked success, and made it possible to operate a drag of 4,000 feet or longer from the guiding launch without an additional observer on the end launch. This requires a lengthening of the tow-line base, which in turn is desirable, as it insures the drag keeping more closely to its proper depth. By properly using the various tenders in changing the drag depth, a longer drag can be used in certain areas than was formerly regarded practicable.

On September 30 the party left Portland, Me., for New Bedford, Mass., via the Cape Cod Canal, arriving at the latter place the following day.

The dragging of Buzzards Bay was begun October 5. The work included the dragging of all areas not finished during the previous season, from a line joining the South Dumping Grounds and West Island to the limits of the work done by the party of Mr. J. H. Hawley, and included some unfinished work in New Bedford Harbor and Quicks Hole. This work was continued until November 7. Owing to unfavorable weather the proposed work in Buzzards Bay was not entirely completed.

The principal shoals located in Buzzards Bay were a 16-foot shoal in Quicks Hole, a 15-foot shoal near White Rock, and a number of shoals in the area northwest of Woods Hole. A special effort was made to complete all unfinished areas in the middle of the bay, but some portions were necessarily left for another season.

After closing work in Buzzards Bay an examination with the drag was made at Newport, R. I., of an area of broken ground between Rose and Goat Islands, three-fourths of a mile in extent. The weather during this work was most unfavorable.

The area in the vicinity of a charted 17-foot shoal was examined with unusual care and soundings were made for more than an hour by three tenders over the entire doubtful area. No important changes were found.

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MASSACHUSETTS.

[N. H. HECK.]

SUMMARY OF RESULTS.—Triangulation: 84 square miles of area covered, 4 stations in main scheme occupied for horizontal measures, 1 station in supplemental scheme occupied for horizontal measures, 18 geographic positions determined. Hydrography: 57 square miles of area dragged, 128 miles run while dragging, 4,783 angles measured, 151 soundings made on uncharted shoals, 1 hydrographic sheet, scale 1: 25,000, partly finished.

After completing necessary preliminary arrangements, work was begun May 10, 1915, on a wire-drag survey of the approaches to the harbor of Boston, Mass. The headquarters of the party was at Hull. Three hired launches were used in this work.

The weather conditions during May and June were favorable, and satisfactory progress was made. The area dragged was of two classes, clear open water and very rocky shoal area. About 42 square miles of the former were finished in May and about 15 square miles of the latter in June. Practically no shoals were found in the former, while 89 shoal spots were found in the latter.

The shoal areas distinctly indicated the need of a drag survey. The bottom is of a different character from that previously dragged elsewhere, though it somewhat resembles that at Portland, Me. The shoals, however, do not extend in well-defined ridges as at Portland. The bottom is rocky but nearly flat over large areas, with sharp rocky points projecting 3 to 8 feet in places. In one section of nearly 8 square miles the lead was dropped at intervals, and only one sounding was obtained with soft bottom and this in a small pocket. All the rest were on rocky bottom.

Tidal information for the reduction of soundings was obtained from an automatic tide gauge maintained at Nut Island by the Metropolitan Water and Sewerage Board, the records of which were kindly placed at the disposal of the surveying party.

A few triangulation stations were occupied for the determination of prominent objects for use as signals.

Improvements in apparatus.—The principal improvement was the adoption of stranded wire cable (Siemens-Martin) for use as the bottom wire of the drag. This had been used by other organizations and had been under consideration by the wire-drag parties for some time. Certain disadvantages in the use of this cable have now been overcome. The advantages are longer life, less resistance, and less weight for the same strength, permitting the use of smaller floats.

New large buoys have been designed and are being constructed. These will have less resistance with greater carrying capacity.

Experiments were made with floats of balsa wood treated by a special process. These floats were found too weak structurally to withstand the heavy wear.

The use of wireless telegraph for communication between the launches is being investigated.

The spacing of area dragged to different depths in plotting has been greatly improved by the adoption of an instrument known as the "wire-drag buoy spacer," constructed at the office of the Survey.

A form of monthly journal for wire drag work has been adopted which makes it possible to estimate the unit cost of the work.

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[J. H. Hawley.]

SUMMARY OF RESULTS.—Leveling: 3 permanent bench marks established. Hydrography: 56 square miles of area dragged, 190.7 miles run while dragging. 1,564 angles measured, 75 soundings made on uncharted shoals, 1 tide station established, 1 hydrographic sheet finished.

Wire-drag work in Buzzards Bay, Mass., begun in May, was in progress at the beginning of the fiscal year, Westport Point being used as headquarters for the party.

On account of lobstering in the region, it was necessary in the early part of the season to mark out the areas to be dragged and this was continued until the early part of September, after which time the fishing operations were not extensive enough to interfere with the work.

A tide staff was established at the mouth of Westport River and connected with permanent bench marks. This staff was used during the entire season. Tidal observations were begun June 30 and discontinued September 29. Enough natural objects were located by triangulation to control the work when used in connection with objects previously determined.

Drag operations were continued throughout the season. The usual methods of wire-drag work were followed, the position of the end launch being determined from the guiding launch. The guiding launch was a double ender, and the drag was set out and taken up over the bow. For setting out, the launch was anchored from the stern. A new type of engine was used to furnish power to the reel.

During the season a breakwater at Salters Point, Mass., was located. Work was closed on September 29.

SUMMARY OF RESULTS.—Triangulation: 10 square miles of area covered, 2 stations in supplemental scheme occupied for horizontal measures, 1 geographic position determined. Hydrography: 50.5 square miles of area dragged, 121.9 miles run while dragging, 753 angles measured, 1 hydrographic sheet partly finished, scale 1: 25,000.

In April, 1915, preparations were made for wire-drag work on the coast of Massachusetts southward from the vicinity of Scituate, Mass. On April 27 the positions of the beacons marking the entrance to the Cape Cod Canal were determined.

The party was organized at Hull, Mass. The guiding launch and tender arrived on May 7. On May 11 the party removed to Scituate. The end launch arrived on May 12 and the first field work was done on May 13.

From May 13 to June 30 wire-drag work was in progress. A 4,000-foot drag was used in shoal water and one 5,000 to 6,000 feet long in deeper water.

Numerous shoals were found in the area examined. All of these were single large bowlders or piles of smaller rocks on a bottom of sand and pebbles. The approximate northern limit for bottom of this character appears to be a line extending east from Minots Ledge Lighthouse. It seems probable that this formation extends into Cape Cod Bay.

With one exception, less depth than charted was found on every shoal indication, and large patches of bowlders were found in unexpected places. Six separate piles of bowlders were found in an area

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supposed to be free from obstructions, with depths over them of 25½ to 41 feet. The charted depths in the vicinity were 48 to 66 feet.

In addition to the usual trouble with lobster traps, the work was interfered with by a large number of mackerel nets. These nets float on the surface and are anchored at the bottom, while the lobster traps rest on the bottom.

The usual practice was observed of marking out sections in shoal water for the operation of the drag and giving advance notice to fishermen of the dates when work would be done.

A larger launch than usual was used as an end launch with satisfactory results.

A few objects were located by triangulation for the control of the work.

A wireless practice set was established on the guiding launch by means of which weather reports, etc., were received daily from Boston. It is proposed to test this means of communication when a 24,000-foot drag is used later in the season.

[ISAAC WINSTON.]

SUMMARY OF RESULTS.—Triangulation: 22 square miles of area covered, 8 signal poles erected, 14 old triangulation stations recovered, 11 intersection points recovered, 3 new triangulation stations established, 14 stations occupied for horizontal measures, 23 geographic positions determined.

Between August 4 and October 22 a revision was made of the triangulation and topography in the vicinity of Salem, Mass.

Preparations for field work were made and several triangulation stations and tidal bench marks were recovered by August 13, when the work was temporarily suspended. Field operations were resumed on September 22 and continued until the work was completed on October 22.

The following old triangulation stations were recovered: Bakers Island Light, Bald Hill, Bolles, Coddon, Coney Island, Derby Wharf Light, F[1] U. S. E., Folly Hill, Fort Pickering Light, Great Haste, Great Misery, Hospital Point Light, Lee U. S. E., Leggs Hill, Marblehead, and North Gooseberry Rock.

The following objects, of which the positions were previously determined, were recovered: Abbott Hall (Marblehead), Abbott Rock, Stone Beacon, tall spire with turrets 1900 (Beverly), Bowditch Ledge Beacon, Great Aqua Vitæ, Halfway Rock, Hardy's Rock, Little Haste, Marblehead Black Top Church, Marblehead Rock Beacon, Marblehead standpipe.

The positions of 21 aids to navigation and prominent objects useful as landmarks were determined. A number of tidal bench marks were recovered.

Various town plans and maps were obtained and corrected where necessary to show present conditions, and these have been filed with a chart on which the positions of new wharves and the location of railway lines within the limits of chart 244 are shown. The water fronts of the towns were examined and changes were noted.

Information was obtained from the United States Engineer's office at Boston, the State Board of Harbor Commissioners at Boston, and the city engineers at Beverly, Manchester, and Salem.

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MASSACHUSETTS AND NEW YORK.

[PAUL C. WHITNEY, Commanding Steamer *Hydrographer*.]

SUMMARY OF RESULTS.—Triangulation: 35 square miles of area covered, 15 signal poles erected, 20 stations in main scheme occupied for horizontal measures, 60 geographic positions determined. Leveling: 3 miles of levels run, 5 permanent bench marks established. Hydrography: 107 square miles of area covered, 842.8 miles run while sounding, 9,310 angles measured, 39,232 soundings made, 4 tide stations established, 7 hydrographic sheets finished, scales 1:10,000 and 1:20,000.

During the six months ending December 31, 1914, the party on the steamer *Hydrographer* was engaged in a hydrographic resurvey of Long Island Sound between Execution Rocks and Norwalk Islands, including Oyster Bay, also a resurvey of a part of Pollock Rip Slue. Work was closed for the season on December 3 and the ship proceeded to Baltimore for repairs.

The hydrography in Long Island Sound consisted in running intermediate lines of soundings between lines in the old work, developing all doubtful areas, locating all aids to navigation not before located, and showing all improvements along the shore that could be determined from the sounding launch. The inshore areas along the north shore and in the vicinity of Oyster Bay were developed with the launch, and the area of the Sound proper was covered by the ship.

Signals were determined by sextant cuts observed at the different triangulation stations, and consisted of water tanks, flag poles, cupolas, chimneys, etc. Owing to the presence of so many natural objects no signals had to be built. The weather during July was unfavorable for rapid progress.

In the launch work there were discovered 18 rocky shoals, all of which were menaces to navigation and not hitherto known. In addition there were discovered and located numerous rocky patches with from 20 to 30 feet of water on them. All of the dangers located were immediately reported and were published in the Notices to Mariners.

The finding of so many shoals with the lead alone in areas already surveyed and used so extensively by shipping shows the prime necessity of dragging such areas.

Bench marks were established at Stamford, Conn., and at Oyster Bay, N. Y. At Stamford permission was obtained to put a bronze marker, in addition to others, in the Stamford Yacht Club building, which was in course of erection. At Oyster Bay two bronze markers were placed, one in the town hall and one in a bank building.

At Saugatuck the United States Army Engineers' bench marks were connected with the bench marks of the Survey by a line of levels, thus ascertaining the relation of the plane of reference used by the Engineers to that of the Coast and Geodetic Survey.

In Oyster Bay and Cold Spring Harbor the hydrography was executed, and in addition a tertiary scheme of triangulation was observed which will serve as a basis of a new topographic survey. All prominent objects were cut in and described.

In the vicinity of Throgs Neck a search was made for some reported shoal soundings, but they were not found.

In the middle of November work in Long Island Sound was suspended and the ship proceeded to Monomoy Point, Mass., to search for reported shoals in Pollock Rip Slue. It was found that nun buoy

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No. 2 had shifted so far south-southwest as to leave unmarked a 16-foot spot in the fairway, and it was concluded that this was the shoal that had been struck. Hydrography was executed to cover the doubtful area. Upon the completion of this survey the ship returned to Oyster Bay and finished the work in that vicinity.

Assistance was rendered a motor boat with broken tail shaft belonging to J. S. Blackton, vice president of the Vitagraph Co. She was towed by the *Hydrographer* to Oyster Bay, where further help could be obtained.

RHODE ISLAND, CONNECTICUT, NEW YORK, AND NEW JERSEY.

[E. F. DICKINS.]

Inspection duty for the region included between Narragansett and Delaware Bays has been continued by an officer who is in charge of the suboffice of the Survey in the Customhouse Building, New York City.

The duties of the inspector are to obtain information in regard to reported dangers for the correction of charts, Coast Pilots, and Notices to Mariners; to furnish information in regard to charts, Coast Pilots, tide tables, and other publications of the Survey; to supervise the construction and shipment of material needed for the repair or outfit of vessels and boats of the Survey; and to receive and forward instruments or material for the field parties and vessels.

Every effort has been made to bring the Survey in close touch with the maritime public, to ascertain their needs, and to meet them as promptly as conditions will permit.

In the latter part of June, 1915, arrangements were made for keeping for sale a stock of charts and publications of the Survey at the suboffice.

CONNECTICUT AND NEW YORK.

[J. T. WATKINS.]

In August a field revision was made and information collected from the offices of the United States Army Engineers and other sources for the correction of Coast Pilot, Part IV, Point Judith to New York. Visits were made for this purpose to New Haven, New London, and Albany.

On the return trip from Albany examinations of reported dangers were made and the positions of aids to navigation determined at the north end of Esopus Island, and a 9-foot rock was located in the channel of the Hudson River just above Iona Island. This work was completed August 31.

NEW YORK.

[F. G. ENGLE, Commanding Steamer *Hydrographer*.]

SUMMARY OF RESULTS.—Leveling: 3 miles of levels run. Hydrography: 13 square miles of area covered, 137.4 miles run while sounding, 1,616 angles measured, 5,320 soundings made, 2 tide stations established, 1 hydrographic sheet partly finished, scale 1:20,000.

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On June 15, 1915, the party on the steamer *Hydrographer* began a hydrographic resurvey of the channels at the entrance to New York Harbor.

Tidal data for this survey were obtained from an automatic tide gauge maintained by the Corps of Engineers, United States Army, and from a tide staff established on the iron steamboat pier at Coney Island. This staff was connected by leveling with the Engineer's staff and bench mark on the old iron steamboat pier.

Sounding was begun June 17 in the vicinity of West Bank Lighthouse and continued whenever weather permitted through the remainder of the month.

The area surveyed up to the close of the fiscal year lies southward of Ambrose Channel, between the limits of the United States Army Engineer survey and Sandy Hook, and as far north as West Bank Lighthouse. The western limit includes the old main channel. Sounding lines were run 100 meters apart and soundings were taken frequently at a speed of 3½ to 4 knots. Strong variable currents in the vicinity of Sandy Hook made difficult the proper spacing of lines at this slow speed. Soundings were taken only in moderate weather and comparatively smooth water.

The positions of West Bank Lighthouse and North Beacon, Sandy Hook, were determined.

[H. C. DENSON.]

SUMMARY OF RESULTS.—Triangulation: Area in square miles, 85; signal poles erected, 12; observing tripod and scaffold built (height 15 feet), 1; stations occupied for horizontal measures, 13; geographic positions determined, 69. Topography: Area surveyed in square miles, 50; topographic sheets finished, 4, scales 1:10,000 and 1:20,000. Hydrography: Area sounded in square miles, 15; number of miles run while sounding, 242; number of positions determined, 1,347; number of soundings, 8,613; number of tidal stations occupied, 5.

The work of chart revision along the shores of Great South Bay and Fire Island Inlet, Long Island, was in progress July 1 and continued until October 31.

The triangulation was started from the line Nicoll-Island, previously determined, and extended eastward through five figures to Smiths Point, a distance of 16 miles. The geographic positions of all prominent objects, such as factory chimneys, windmills, standpipes, etc., of a permanent nature, were carefully determined, so that in the future topographic and hydrographic revision in this locality sufficient points should be available to readily carry on the work without additional triangulation. Many of these objects may be used in the work of offshore hydrography.

The topography of this section was found to have greatly changed since the last survey. Numerous improvements have been made along most of the shores of Great South Bay, additional beach resorts and summer colonies have been established, canals dug, and bulkheads erected, and the old settlements and villages have expanded considerably.

No marked change has occurred in the general shore line, except around the inlets. Point Democrat, westward of Fire Island Lighthouse, has extended about one-fourth mile farther westward than shown on the present chart; Oak Island Beach has receded approxi-

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mately 300 feet; Gilgo Inlet has entirely closed; and changes have occurred at Jones Inlet.

The only changes in the hydrography of Great South Bay from that shown on the existing chart are in the vicinity of the inlets and where dredging has been done in the creeks and canals. A careful survey was made of Fire Island Inlet and the bar. The results of this survey show a channel with a depth of 9 feet over the bar at mean low water.

The channel has changed its course from that shown on existing charts and now runs along Oak Island Beach. It is buoyed and has been in use for two years. The bar and channel leading into Fire Island Inlet are subject to rapid changes, and are almost invariably affected by severe southerly gales. Lines of soundings were run from the mainland to the beach resorts, but no changes were noted from the information as now published.

Numerous piers of a temporary character are built in the bay from the beach resorts and remain during the summer months, but are taken up for the winter on account of ice. A depth of 4 feet at low water will be found at the end of these piers. All creeks and canals affording sufficient depths for motor boats were carefully sounded, but the depths at the mouths of these are constantly changing. A hydrographic reconnoissance of the entire bay was made, with the result that the depths found conformed to those that appear on the existing chart.

[P. C. WHITNEY, Commanding Steamer *Isis*.]

The steamer *Isis* was put in commission in the latter part of May, 1915, having been chartered by the Survey until the appropriation for her purchase should become available.

The vessel took part in the naval review at New York on May 17 and 18. On May 19 the *Isis* sailed from New York for Washington, arriving on the morning of May 21. From May 21 to June 6 the vessel was used for inspection trips down the Potomac River and in Chesapeake Bay.

On June 7 the ship was inspected by the local steamboat inspectors. During the remainder of the month the vessel was at the Washington Navy Yard outfitting, and the officers were engaged in drawing up plans and specifications for certain proposed changes to be made to the vessel after July 1.

[E. B. LATHAM.]

SUMMARY OF RESULTS.—Topography: 36 square miles of area surveyed, 107 miles of general shore line surveyed, 12.5 miles of roads surveyed, 3 topographic sheets finished, scale 1:10,000. Hydrography: 20 square miles of area covered, 961.4 miles run while sounding, 7,576 angles measured, 41,190 soundings made, 3 tide stations established, 4 current stations occupied, 3 hydrographic sheets finished, scale 1:10,000.

The topographic and hydrographic survey of Jamaica Bay, N. Y., begun in May, 1914, was in progress at the beginning of the fiscal year. The plane-table work was completed on September 4.

The shore line was transferred to projections furnished by the office from old topographic sheets, and from a blue print of a drawing compiled by the department of docks and ferries of the city of

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New York from surveys by the Coast and Geodetic Survey and other sources. These sheets were then taken into the field, and where the shore line had changed and along the main channels and shore the shore line was rerun to a junction with the transferred shore line. All changes were noted and joined in correct position with the old work. Numerous stacks, chimneys, spires, and other objects were determined as a control for the hydrography and topography and to afford objects from which the position of aids to navigation may be determined.

The hydrographic work was begun on September 10 and continued until December 12. From December 12 to December 22 additional topographic work was done of connecting the street plans with the objects determined with the plane table. Exceptionally good weather conditions prevailed in September and October and a part of November. In October soundings were made on 21 days, 412 miles of sounding line were run, and 17,512 soundings were made.

Positions of aids to navigation for channels into Sheepshead Bay and Jamaica Bay were furnished for use on the charts.

NEW JERSEY.

[R. P. Strough.]

SUMMARY OF RESULTS.—Leveling: 29.4 miles of levels run, 10 permanent bench marks established.

In October and November a line of precise levels was run between Perth Amboy and Sandy Hook, N. J., connecting bench mark "R" at Keyport, the State Geological Survey bench mark at Perth Amboy, and bench mark "C" on Sandy Hook. This work was done in accordance with the general instructions for precise leveling, the line being run in both directions and all sections checked within the required limit. The line was carried along the railroad track, using the rail for the rod supports. Transportation for the party was by an electric car line.

Besides the 3 bench marks recovered from the old work, 10 new permanent bench marks were established in the 29 miles of line. Connection was also made at Sandy Hook with two of the United States Army bench marks, one known as the ordnance bench mark, which is in front of the proving ground office, and the other known as the Engineers' bench mark, at the northeast corner of the Engineers' building. The latter was also connected directly with the tide staff at Sandy Hook.

NEW JERSEY, DELAWARE, MARYLAND, AND VIRGINIA.

[L. A. Potter.]

Field revision of Coast Pilot, Section C, including the coast from Sandy Hook, N. J., to Cape Henry, Va., which had been temporarily suspended June 23, was resumed on July 9. Between this date and August 27 an examination was made of the navigable tributaries of Chesapeake Bay from Norfolk to the head of the bay on the western shore, and from Miles River to the head on the eastern shore. The

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tributaries were visited by regular steamer lines wherever possible, otherwise by hired launches operated by pilots familiar with the locality.

On September 7 an examination was begun of the interior channels and inlets on the coast of New Jersey from Cape May to Sandy Hook. This work was done in hired launches, operated by local pilots, and was completed on September 18. An examination of Delaware Bay and River was then begun. Much of the information concerning the smaller tributaries of Delaware Bay was obtained by interviews with boat owners and captains, the tributaries being visited by means of regular steamers where necessary. This section of the work was completed on October 2.

NEW JERSEY.

[STEHMAN FORNEY.]

SUMMARY OF RESULTS.—Reconnoissance: Length of scheme, 12 miles; 26 square miles of area covered, 92 lines of intervisibility determined, 66 points selected for scheme. Triangulation (tertiary): 20 square miles of area covered, 90 signal poles erected, 63 stations in main scheme occupied for horizontal measures, 93 stations in supplemental schemes occupied for horizontal measures, 145 geographic positions determined. Topography: 19 square miles of area surveyed, 97 miles of shore line of rivers and creeks surveyed, 50 miles of roads and railroads surveyed, 5 topographic sheets finished, scale 1:5,000. Hydrography: 4½ square miles of area covered, 13 miles run while sounding, 158 angles measured, 918 soundings made, 1 tide station established, 2 hydrographic sheets finished, scale 1:5,000.

From July 1 to September 14 work was continued on the topographic survey of the Passaic River. This work was executed on a scale of 1:5,000, and includes much detail in the vicinity of the city of Passaic, such as wharves, docks, bridges, and trolley and steam railroads. Surveys by city and county engineers were utilized for lines of streets, etc.

On September 15 work was begun on the survey of the Hackensack River, and was completed by April 30. It was found necessary to erect observing tripods for the triangulation, in many places from 9 to 14 feet in height, to see over the high meadow grass. A portable observing scaffold 9 feet in height designed and built by the party was successfully used.

The tertiary triangulation of the river was extended to Anderson Street Bridge in Hackensack and was completed January 4. It was connected with a base line measured on the Anderson Street Bridge by the United States Army Engineers, the computed length of the base as determined by the Coast and Geodetic Survey triangulation agreeing satisfactorily with the measured length. In the early part of the fiscal year the triangulation had been connected with a base line measured by the United States Army Engineers at Little Ferry Bridge.

The topographic survey was also extended to Anderson Street Bridge, and was completed April 22. This work covers three plane-table sheets, scale 1:5,000, and includes the Hackensack River from triangulation station Public to Anderson Street Bridge. The detailed topography was carried into the interior one-half mile from the shores of the river.

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The shores of the river from its mouth to the town of Hackensack are bordered by low meadow land, interspersed with small, crooked creeks, except at Snake Hill, which is an isolated hill of trap rock rising abruptly out of the lowland to an elevation of 208 feet above mean high water. Little Snake Hill to the eastward is also an isolated hill rising abruptly out of the meadow and has an elevation of 80 feet above mean high water. New Canal cut into Berrys Creek, on the west shore of the Hackensack, was excavated by the Erie Railway Co. This canal shortens the distance between the river and Rutherford, N. J., and is the only route with 12 feet draft at mean low water to Rutherford. The canal is navigable for light-draft motor boats to Carlstadt, N. J.

Local maps furnished by the municipal engineers were used where practicable for details of streets, buildings, and in some places for contours in the towns and villages.

A rapid reconnoissance was made of the river above Anderson Street Bridge. For about 2 miles above the bridge both shores are low and marshy; from there upward the banks become steeper and the river is contracted until at New Milford it is but 25 meters wide.

The hydrography of the Hackensack from Sawmill Creek to triangulation station Brick was surveyed between March 23 and April 16. This portion of the river had not been sounded or dredged by the United States Engineers, as the depth is 12 feet or more. There are strong tidal currents in the river. Numerous creeks emptying into Hackensack River are navigable for small boats.

The Army Engineers are maintaining a dredged channel 150 feet wide and 12 feet deep at mean low water from the mouth of the river to the Court Street Bridge at Hackensack.

Tides were observed at Patterson Plank Road Bridge during the progress of the hydrographic work.

On May 1 the party proceeded to Perth Amboy, N. J., and began a resurvey of Arthur Kill. Observation of horizontal angles was begun May 25. A scheme of triangulation was developed, based on stations of existing triangulation by the Federal and State authorities, and connected with the triangulation of the Coast and Geodetic Survey.

Observations for the triangulation of Arthur Kill were completed June 21.

[E. B. LATHAM.]

The determination of points and erection of signals for use in offshore hydrography on the coast of New Jersey was begun June 19. On June 29 the work was completed between Barnegat Inlet and Belmar.

All prominent objects along shore or visible therefrom were determined in position, and poles 16 feet in height with flags on them were placed and determined about 1 mile apart. Two or three smaller poles were placed between the higher flagpoles. The most northern and southern houses in each town, also all isolated houses or those of characteristic outline, were determined and described.

Only where the topographic features could be obtained without delaying the determination of objects for use in the hydrography was any attempt made to fill in the topography. The main road, a well paved State highway, and the new bridge across Barnegat Bay

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were determined. A portion of the shore line in the vicinity of Barnegat Inlet was rerun, as the position of the inlet has materially changed from previous determinations.

Signals were erected by June 30 south from Beach Haven to Barnegat Inlet, and signal material and transportation were arranged for to continue the work during the next fiscal year.

Azimuth and distance were carried by plane-table and stadia readings for a distance of 23 miles and all prominent objects were located.

[J. B. BOUTELLE, Commanding Steamer *Endeavor*.]

SUMMARY OF RESULTS.—Triangulation: 224 square miles of area covered, 10 signal poles erected, 8 stations occupied for horizontal measures, 10 geographic positions determined. Hydrography: 79 square miles of area covered, 1,325 miles run while sounding, 8,230 angles measured, 43,000 soundings, 3 tide stations established, 2 hydrographic sheets finished.

Between June 11, 1914, and October 2, 1914, the party on the steamer *Endeavor* was engaged in hydrographic surveys at the entrance to Delaware Bay.

A signal, Fly, was established on the eastern shore of Delaware Bay, about 3 miles north of Cape May, and from this and the various lighthouses, which were old stations, a number of objects in Cape May and the new lighthouses at Brandywine Shoal and Dead man Shoal were determined. At Cape May a number of objects previously determined approximately were reobserved and determined, and also the large pavilion at Cold Spring Harbor.

The hydrography was extended from the shore line at Cape May, from a point about opposite the large Cape May Hotel, southward to beyond the 6-fathom curve on the edge of the main ship channel and northward up Delaware Bay to Deadman Shoal and vicinity. Enough of the south and west sides of Crow Shoal were included to join the new 3-fathom curve with the old. That part of Crow Shoal north and east of the 1914 work was crossed at numerous places while under way with the ship running on course and time sounding, but no indications of changes were found in this area. Very extensive changes were found in the shoals and channels south and west of Cape May. The old shoals have changed in position and extent and new channels have been formed. These changes were all followed out and developed. Deadman Shoal was found to have cut away somewhat at the northwest end and extended slightly on the east side. More extensive changes were found on the shoals southwest of Deadman Shoal and these were followed out and developed. The work was closed October 2.

PENNSYLVANIA.

[E. B. LATHAM.]

In April a revision was made of the surveys of the water fronts of the city of Philadelphia with a view to obtaining information for the correction of charts of the Delaware and Schuylkill Rivers.

The triangulation of the Delaware River in front of Philadelphia by the United States Engineers was in progress, and arrangements were made to have the results of this work furnished to the Coast

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and Geodetic Survey office when completed. Results of the triangulation of the Schuylkill River were obtained from the authorities of the city of Philadelphia.

Information necessary for the correction of the charts, changes in the location of wharves, piers, etc., were indicated on photographic prints furnished for the purpose. Notes were also collected for use in the preparation of Coast Pilot volumes.

VIRGINIA AND NORTH CAROLINA.

[O. W. FERGUSON, Commanding Schooner *Matchless*.]

SUMMARY OF RESULTS.—Triangulation: 98.5 square miles of area covered, 66 small signal poles erected (for hydrography), 32 large signals erected (average height about 37 feet), 8 stations in main scheme occupied for horizontal measures, 5 stations in supplemental schemes occupied for horizontal measures, 49 geographic positions determined. Leveling: 3.2 miles of levels run, 17 permanent bench marks established. Topography: 19 square miles of area surveyed, 133.2 miles of general coast line surveyed, 51.8 miles of shore line of creeks surveyed, 44.3 miles of roads surveyed, 3 topographic sheets finished, scales 1: 20,000 and 1: 40,000. Hydrography: 267.5 square miles of area covered, 2,036.1 miles run while soundings, 9,601 angles measured, 79,271 soundings made, 6 tide stations established, 4 hydrographic sheets finished, scale 1: 20,000.

The resurvey of the east shore of Chesapeake Bay and its tributaries in the vicinity of Cape Charles, Va., by the party on the schooner *Matchless* was in progress at the beginning of the fiscal year.

The hydrography of the creeks and the close development of all shoal areas, bars, and channels from the shore to a depth of 6 or 7 fathoms were continued until November 30, when the vessel sailed for Baltimore.

The hydrography covered all of the creeks and the bay for a distance of 2 to 5 miles from shore. Special development was made of creek bars and channels.

A special examination was made for a shoal spot with 17 feet of water reported in latitude 37° 37′ 12″ and longitude 76° 01′, but no depth less than 26 feet was found. The mean low-water plane for this work was determined by simultaneous tidal observations at Cedar View Wharf, Nandua Creek, and Onancock, on Onancock Creek.

The shore line of Nassawaddox Creek was surveyed, and 48 miles of telemeter line were run to locate hydrographic signals on this creek and on the main shore of the bay.

The triangulation for control of the hydrographic and topographic work was completed, and the triangulation stations were permanently marked.

A hydrographic survey was made of Nassawaddox, Occahannock, Craddock, Nandua, Butchers, Pungoteague, and Onancock Creeks, and the hydrography remaining to be done in the area from Nassawaddox to Pungoteague Creek and from Pungoteague to near Chesconessex Creek was completed by November 30.

From January 1 to February 28 the schooner *Matchless* was undergoing repairs at Baltimore, outfitting, and en route to the working ground in Albemarle Sound, N. C.

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During the period from March 1 to May 13 the party was engaged on the triangulation, topography, and hydrography of the west end of Albemarle Sound from Bluff Point to Edenhouse Point, including an area about 14 miles long by 11 miles wide.

Triangulation stations, Cypress and Pan, of 1909, were recovered and occupied, and two new stations, Skinner and Capehart, were established and occupied. Observations were made on a sufficient number of points to serve for the control of the hydrographic and topographic work.

The topography of the shores was done on a scale of 1:40,000. Large areas were added to the topography south of Salmon Creek and about Scotch Hall. The topography of Pembroke Creek was well developed to Bolton Bridge, 2 miles above the United States fish hatchery. Large areas were added to the topography around Edenton and in its approaches.

All of the area mentioned was covered by sounding lines about 700 meters apart north and south and 900 meters east and west.

The channels leading to Edenton, the mouth of Roanoke River, and all bars were developed by lines of soundings from 100 to 300 meters apart as required. Particular attention was paid to the 6-foot and 12-foot contours.

The hydrography of Pembroke Creek was carried 4 miles above the United States fish hatchery, or 5 miles from Edenton. Tidal information for the reduction was obtained from an automatic tide gauge maintained by the United States Engineers at the Pembroke fish hatchery and from gauges at Edenton and Laurel Point Lighthouse. Simultaneous readings were made at Edenton and Laurel Point Lighthouse and between the Edenton gauge and the Pembroke gauge. The tide gauges were connected by leveling with permanent bench marks.

The work in the western end of Albemarle Sound was completed on May 14 and the *Matchless* took up the survey of Croatan Sound, including topography and hydrography. Sufficient old triangulation stations were recovered to control the topography and hydrography, and such additional signals as needed were cut in from known points.

The topography of all of the shore of Croatan Sound was excuted on a scale of 1:40,000, all prominent objects on or near the shore line being located. Sounding lines were run north and south one-fourth mile apart, and channels and bars were developed by lines from 100 to 200 meters apart with cross lines about 400 meters apart.

Tides were recorded on a gauge established at Burnside Wharf, on the west side of Roanoke Island.

NORTH CAROLINA.

[P. C. WHITNEY, Commanding Steamer *Hydrographer*.]

SUMMARY OF RESULTS.—Triangulation: 40 square miles of area covered, 12 signal poles erected, 10 observing tripods and scaffolds built, heights 20 to 55 feet, 14 stations in main scheme occupied for horizontal measures, 20 stations occupied for vertical measures. Magnetic work: 1 sea station occupied for magnetic declination. Topography: 15 square miles of area surveyed, 45 miles of general coast line surveyed, 5 miles of rivers surveyed, 2 topographic sheets partly finished, scale 1:40,000. Hydrography: 300 square miles of area cov-

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ered, 857 miles run while sounding, 2,900 angles measured, 24,817 soundings made. 2 tide stations established, 1 hydrographic sheet finished and 1 partly finished, scales 1:20,000 and 1:30,000.

At the beginning of January the *Hydrographer* was undergoing repairs at Baltimore, Md., and the officers of the vessel were engaged in the completion of the records of the previous season's work.

On January 16 the ship left Baltimore to take up a resurvey of Albemarle Sound, N. C., going by way of the Chesapeake and Albemarle Canal.

Headquarters were established at Hertford, about 11 miles up the Perquimans River, where coal and provisions could be obtained. There being no regular means of water supply, a pipe line was run from a private water tank to a near-by wharf. Coal for the vessel was delivered at the same wharf.

The work was done in cooperation with the party on the schooner *Matchless*, the *Hydrographer* doing as much as possible of the work in the more exposed localities and the sheltered portions being left for the *Matchless*.

The triangulation was extended from the line Batts 2–Laurel Point Lighthouse of the work of 1909 to the mouth of Perquimans River and well up toward Hertford. Considerable difficulty was experienced in joining the river triangulation with the long lines in the sound, and to accomplish this it was found necessary to erect a signal in 20 feet of water in the sound.

All shore stations established were securely marked with standard station marks set in concrete and reference marks were placed at each station.

The topography on the north shore of the sound covered the shore from Bluff Point to Harvey Point, except Yeopin River; 5 miles eastward from Canaan Cove, Perquimans River; and eastward from the mouth of Little River to Wade Point, including the greater part of Flatty Creek. On the south side of the sound the topography included the shore line from 2 miles east of the Scuppernong River to Long Shoal Point, Alligator River. The shore line was difficult to survey, consisting largely of wooded marsh. On the north shore it was necessary to run plane-table traverse lines connecting the triangulation points to control the topography. At places dead stumps extend out to quite a distance from the shore line, making navigation for small boats dangerous. There are few objects of importance to the navigator along these shores and no settlements except a few fish houses and wharves.

The hydrography, which was the principal work done, covers nearly all the water areas of the main body of the sound from Bluff Point to Powells Point. The inshore and sheltered portion of the work was left to be done by the party on the schooner *Matchless*. The distances being great, it was necessary to erect tall hydrographic signals. One of these, at station Wade, was observed on at a distance of 12 nautical miles. This signal was constructed in one working day, which includes the work of cutting trees, etc. The highest part is 55 feet above the water and the lowest part of the visible section is 36 feet.

Tide gauges were established and tidal planes determined at Laurel Point Lighthouse and Wade Point Lighthouse.

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Field work in Albemarle Sound was discontinued April 20 and the vessel proceeded to Baltimore.

[E. H. PAGENHART.]

SUMMARY OF RESULTS.—Triangulation (tertiary): 130 square miles of area covered, 24 signal poles erected, 10 stations in main scheme occupied for horizontal measures, 17 stations in supplementary schemes occupied for horizontal measures, 46 geographic positions determined.

Work was begun May 14 on the determination of geographic positions of aids to navigation in Core and Bogue Sounds, N. C. This work was undertaken at the request of the Bureau of Lighthouses.

A launch and a house boat were chartered at Beaufort for the use of the party, and actual field work began on May 18. Twenty-five old triangulation stations were recovered and occupied and two new ones established and occupied by June 10, when the field work was completed. When this work was undertaken all of the lights necessary for the navigation of Core and Bogue Sounds were in place, the structures were of substantial concrete construction, and no changes in the lighting were contemplated, so that with the lights determined in position and plotted on the charts and the triangulation stations permanently marked and described, any future changes deemed necessary in the aids to navigation may readily be made by the officers of the Lighthouse Service.

At most of the stations the work consisted in observing a round of horizontal directions (direct and reverse) on the stations, lights, and natural objects. Where no suitable natural objects for aids to navigation were visible, marks were placed in trees close to the station and located by tape or intersection. These marks were usually made of eight wooden strips, 2 by 4 inches and 4 feet long, painted white and spiked to large and prominent trees. They will serve as points for hydrography, topography, and triangulation. A special effort was made to locate all church spires, club houses, and other prominent objects. At each station occupied all objects visible which are suitable for the purposes sought were observed upon. Many reference points were occupied and a round of observations taken on all prominent objects, including the station. Many of the lights were occupied with a sextant to furnish directions to objects which could not well be determined from the shore stations alone.

SOUTH CAROLINA.

[ISAAC WINSTON.]

On July 1 the construction of seven large hydrographic signals on the coast of South Carolina for the use of the party on the steamer *Bache* was in progress. A hired motor boat was used for the transportation of the party. Lumber for the signals in most instances had to be towed a long distance to the nearest point on the beach to the locality where it was to be used and then carried by hand to the desired location.

Tripods 35 feet in height, strongly braced and anchored in the sand, were erected. A 4 by 4 inch pole was extended above the tripod, to which the upper portion of the target was fastened, and galvanized wire guys were attached as an additional safeguard.

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Targets 10 by 12 feet in size were placed on the signals, with the bottom of the target 40 to 50 feet above sea level. It was afterwards found necessary to board up the signals on the ocean side to make them show more distinctly against the background of the woods.

Observations on known positions were made from the signals wherever visible, and from Cape Romain and Georgetown Lighthouses on such signals as could be seen from them. This work was completed July 13.

SOUTH CAROLINA, GEORGIA, AND FLORIDA.

[R. F. Luce, Commanding Steamer *Bache*.]

Summary of results.—Triangulation: 65 square miles of area covered, 10 stations occupied for horizontal measures, 5 geographic positions determined. Magnetic work: 1 shore station occupied, 3 sea stations occupied. Hydrography: 10,572 square miles of area covered, 54 stations occupied by ship for location of signals, 988 angles measured (sextant cuts to locate signals), 19 shore objects located by ship angles, 73 offshore buoys and objects located by ship angles, 6,470 angles measured (to determine position while sounding), 8,267 miles run while sounding, 105,017 soundings made, 468 current stations occupied, 1,778 current observations taken, 4 tide stations established.

The hydrographic surveys by the party on the steamer *Bache* on the coast of South Carolina between Bull Bay and Georgetown Jetties were in progress at the beginning of the fiscal year. The command of the vessel was transferred to the present commanding officer July 6. By that date tide stations had been established at Georgetown and Cape Romain, S. C., two triangulation stations had been occupied to locate shore signals and buoys, and arrangements had been made to borrow buoys for the survey from the Lighthouse Service. High shore signals had been built along the coast from Charleston to Georgetown by another party. The work after July 6 was to locate these signals by triangulation and sextant angles, to place the buoys to be used in the survey, and to sound over the area between Charleston and the Georgetown Jetties, extending from the 3-fathom curve out to the 100-fathom curve. This work was completed by October 23, and the *Bache* proceeded to Norfolk for repairs.

The shore signals erected prior to July 6 at various points along the coast were named as follows: Dewees, Price, Bull, Raccoon, Santee, South, and North. Station Bull was the site of an old lighthouse which had been previously located by triangulation, and cuts had been taken on stations Santee and South from Romain and Georgetown Lighthouses. As it was the intention to locate the remainder of these stations subsequently by triangulation, it was deemed sufficient for immediate use to locate them by sextant cuts from the ship at anchor offshore, although additional triangulation cuts were obtained on a few of them.

Inasmuch as the coast in this vicinity is very flat, without hills or even high sand dunes, it was impossible to get locations for the hydrography from shore signals more than about 9 miles from shore, and as the 10-fathom curve runs parallel to the coast and about 15 miles offshore it was impossible to get locations from shore objects for several miles inside the 10-fathom curve. Since it was deemed of prime importance to make a careful development out to and be-

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yond the 10-fathom curve, and it was not considered sufficiently accurate to attempt to develop this outer area by dead reckoning, it was decided to use buoys dropped in a line parallel to the shore at frequent intervals as far offshore as they could be accurately located. Six first-class bell and whistle buoys were loaned by the lighthouse inspector at Charleston for this purpose; and in order to make them visible for as great a distance as possible, wooden superstructures carrying a flagpole and a flag were designed for them. The buoys were placed by a lighthouse tender as nearly as possible in the desired location and about 4 miles apart, and they were then located by sextant cuts from the *Bache* anchored at the greatest distance from shore at which it was possible to see shore objects. Sextant angles to locate the ship and to cut in the buoys were taken very carefully with the ship at anchor, and good locations of the buoys were thus obtained. As the work covered a greater stretch of the coast than could be covered by the six buoys at one time they were shifted by the lighthouse tender from time to time as required.

The inshore hydrography covers the area between Charleston and Georgetown Jetties, and extends from a depth of between 2 and 3 fathoms inshore to a line of signal buoys placed about 14 miles offshore. All of this work was located by positions either on shore objects or on the signal buoys. The hand lead was used in depths less than 14 fathoms, and the trolley sounding apparatus in greater depths. Lines were spaced slightly less than 1 mile apart and run normal to the coast; but a close development was given to an area of about 30 square miles in the vicinity of Charleston Jetty, and a slightly larger area off Georgetown Jetties. Special care was given to developing areas where shoal or uneven depths were found, and about 36 such spots were closely developed. The total area covered by these developments was approximately 76 square miles. Soundings in all the inshore work were taken from 50 to 150 meters apart, depending upon the depth of water.

At the request of the lighthouse inspector at Charleston, S. C., the position of the wreck of the schooner *Frederick W. Day* off Charleston Light Vessel and the least water over it were determined and published in the Notice to Mariners.

The offshore hydrography covers an area bounded on the inshore side by a line of buoys about 14 miles offshore, and extends seaward to outside the 100-fathom curve. The lines were run in a northwest and southeast direction, and in all an area of about 1,800 square miles was covered. All of this work was done by dead reckoning, and lines were spaced 4 miles apart. All patent logs used in the work were carefully standardized, and the ship was swung three times for compass deviation. On the dead-reckoning lines the ship was anchored every two hours for current observations, and the resultant of the two observations made at start and finish of the two-hour run was used to correct the course steered. At the 100-fathom curve current observations were taken from an anchored buoy by means of a current pole and line from a small boat. Astronomic observations on the sun and stars were taken when possible on these lines. Up to 15 fathoms the soundings were taken with the hand lead. At greater depths a trolley sounding apparatus was used with a special device for reeling in the line by steam.

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In addition to the current observations before mentioned, currents were observed every half hour day and night whenever the ship was at anchor on the working ground and the sea was not too rough. An anemometer was installed on the ship and the velocity of the wind taken at the same time with the current observations.

An automatic tide gauge was maintained during the work at the Georgetown Jetty, and continuous staff readings were made day and night at Cape Romain, near the lighthouse, to facilitate the reduction of soundings.

On January 1, 1915, the *Bache* was at Norfolk, Va., undergoing extensive repairs. These being completed, the vessel sailed for the working ground on February 19 to make hydrographic surveys off the coasts of Georgia and Florida. For this work a separate party had been engaged in building tall signals along the coast and determining their positions. The work of the *Bache* after February 19 consisted in adapting, placing, and determining the position of survey buoys; magnetic observations in Chesapeake Bay and on the working grounds; and sounding over the area between St. Simons Lighthouse, near Brunswick, Ga., and a point about 5 miles south of the jetties at the entrance to St. Johns River, Fla., and extending from the 3-fathom curve out to the 100-fathom curve. This work was completed by June 20, when the vessel sailed from Fernandina, Fla., for Baltimore, Md., for overhauling and repairs.

In February, 1915, six shore signals had been erected by Mr. J. S. Bilby on the coasts of Georgia and Florida for the use of this party, five of them being new stations and one an old triangulation station. A number of other points, such as lighthouses, water tanks, and windmills which had previously been determined in position, were used by the vessel in the location of soundings. These signals proved more satisfactory than any previously used in similar work, being tall enough to show over the tops of any trees either near the coast or farther inland, so that they were plainly visible in the morning when the sun was shining on their front surfaces and in the afternoon when the sun was back of them.

At the request of the lighthouse inspector at Charleston, S. C., the new St. Andrews Sound Lighthouse and two channel beacons in St. Andrews Sound were located by triangulation, two stations being occupied for that purpose.

In the work off the coasts of Georgia and Florida the same system of offshore signals was used as in the previous work off the coast of South Carolina. Six first-class bell and whistle buoys were loaned by the inspector of lighthouses at Charleston, and superstructures were installed on them to make them visible to as great a distance as possible. The superstructures were of the same design as those used in the previous work; but extra heavy 1-inch pipe was substituted for the three-fourth-inch pipe used in their construction, and plain black flags were used instead of the international code flags previously used, and this change increased the visibility of the signals considerably. Experiments were made to determine the proper distance apart these buoys should be spaced, and it was found that 4 miles was the most economical spacing consistent with the accurate location of sounding lines.

The buoys were dropped by a lighthouse tender as close as possible to the desired location. They were then located by sextant cuts from

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the steamer anchored at frequent intervals at the greatest distance offshore from which shore objects could be seen. Sextant cuts to locate the ship and cut in buoys were taken very carefully with the ship at anchor, and angles all around the horizon were taken to close the circle as in triangulation as far as possible; very good locations of the buoys were thus obtained. The buoys were shifted from time to time by the lighthouse tender as required.

The inshore hydrography extends from St. Simons Lighthouse to 5 miles south of the jetties at the entrance to the St. Johns River, Fla., and from the 3-fathom curve inshore to about 2 miles outside a line of survey buoys placed about 13 miles offshore; a few lines and some development work were done outside of this in clear weather when the buoys showed plainly. All of this work was located by sextant positions either on shore objects or on the signal buoys. All soundings were taken from the ship with the hand lead. Lines were spaced usually slightly less than 1 mile apart and run normal to the shore line. Off the entrances to Fernandina, Brunswick, and the St. Johns River, over an area in each case of about 40 square miles, lines were spaced not over one-half mile apart. Special care was taken to develop areas where shoals or uneven depths were found, and about 30 such areas were closely investigated. Soundings were taken from 50 to 150 meters apart.

At the request of the lighthouse inspector at Charleston, a small amount of launch work was done between the jetties at Fernandina, Fla. On the way south the shoalest water on the wreck of the schooner *Frederick W. Day*, off Charleston Light Vessel, was determined.

The offshore hydrography covers an area bounded on the inshore side by a line of buoys about 13 miles offshore and extending offshore to outside the 100-fathom curve. The lines were run in an east and west direction, the most northerly line beginning about 8 miles north of buoy A, due eastward of St. Simons Lighthouse, Ga. The most southerly line began at buoy M, due east of the Continental Hotel and 5 miles south of the jetties at the entrance to St. Johns River, Fla. All of this work was done by dead reckoning, lines being spaced 1 mile apart to just outside the 10-fathom curve, 2 miles apart out to the end of the inshore hydrographic sheet, and 4 miles apart out to the 100-fathom curve, except that from the northern end of the work to Brunswick Light Vessel lines were spaced not more than 1 mile apart out to the end of the inshore hydrographic sheet on account of the very uneven character of the bottom. Each line started from a fixed position near the inshore end of the line of survey buoys and extended out to the 100-fathom curve and back to connect with a location from the buoys again. Great care was exercised in the dead-reckoning work to make it as accurate as possible. Patent logs used were carefully standardized. The ship was swung four times for compass deviation. Current observations were taken from the ship at anchor at frequent intervals and the results used to correct the courses steered. Astronomical observations were taken on the sun and stars when practicable. Sea-water temperatures were taken at frequent intervals on all dead-reckoning lines. Mean velocities of the wind were obtained for each two-hour section of the line to determine leeway for different wind velocities. Soundings were taken with the hand lead up to 15 fathoms and with a trolley apparatus,

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with a special device for reeling in the line by steam, at greater depths. Soundings were taken at intervals of from one to five minutes, the vessel running at a speed of 4 to 4½ knots until a depth was reached where a vertical sounding could not be obtained. This usually occurred at 30 to 40 fathoms. It was then found expedient to run full speed for three minutes and stop the engine for two minutes, the sounding being then taken. The soundings on the line were spaced from 150 meters apart in shoal water to 2 miles apart in deep water.

Current observations were taken every half hour, day and night, when the ship was at anchor, and anemometer readings were taken at the same time to determine wind velocities. On a few of the lines the 100-fathom curve came in the Gulf Stream and a current velocity of nearly 3 knots was encountered.

Tidal records were obtained from automatic tide gauges at Fernandina and St. Augustine, Fla., and from a tide staff on St. Simons Island.

FLORIDA.

[H. C. DENSON.]

SUMMARY OF RESULTS.—Triangulation: Area in square miles, 37; signal poles erected, 25; observing tripods and scaffolds built, 1, height 20 feet; stations occupied for horizontal measures, 14; geographic positions determined, 31.

At the request of the United States Bureau of Fisheries a scheme of triangulation was extended from Apalachicola Bay through St. Vincent Sound, Fla., in order to furnish points for a survey of the oyster beds existing in the latter body of water.

This triangulation was started from the line St. Vincent Point 2–St. George Lighthouse and extended through seven figures to the head of St. Vincent Sound, a distance of 20 miles, where a connection was made with the station Ragged Point, determined in 1860.

Between the main scheme triangulation stations and on points affording the most desirable conditions concrete blocks 8 by 8 inches by 3½ feet were placed in the ground, leaving about 6 inches above the surface; these were appropriately marked and their positions carefully determined. These intersection stations, together with the main scheme stations, afford a sufficient number of points for the hydrographic survey of the entire sound.

In the selection of sites and marking of stations care was taken to guarantee their permanency. The main scheme stations were marked by a subsurface mark buried in concrete 3 feet below the surface. The surface marks consist of a regulation standard disk station mark inserted in a concrete block 8 by 8 inches by 3 feet placed in the ground, leaving about 4 inches above the surface.

The reference marks used were concrete piers about 10 inches square and of varying lengths, placed sufficiently well in the ground to insure their stability; standard reference disks were inserted in these piers. At the station sites where tall marsh grass exists the piers were built of such heights that they top the grass about 1 foot.

The field work was begun November 18 and completed December 23. It was much retarded by fogs and gales and on account of the necessity of waiting for favorable stages of the tide in order to visit some localities where stations necessarily had to be placed.

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On December 24 data sufficient for immediate needs were prepared and transmitted to the Bureau of Fisheries steamer *Fish Hawk*, which had arrived in Apalachicola Bay.

In accordance with the Superintendent's instructions dated December 14, 1914, the automatic tide gauge at Cedar Keys, Fla., was overhauled and put in order.

FLORIDA, ALABAMA, MISSISSIPPI, LOUISIANA, AND TEXAS.

[A. J. ELA.]

In the winter of 1915 the more important harbors and ports on the Gulf Coast were visited, and the inland water routes from Galveston to Corpus Christi and parts of the inland waterway system of Louisiana west of the Mississippi were inspected, using the regular passenger steamers or chartered launches operated by local pilots, in order to collect information for a revision of United States Coast Pilot, Part VIII, Gulf Coast of the United States.

The offices of the United States Enginer Corps, the officials of the Lighthouse Service, local pilots and pilots' associations, and others interested in navigation and shipping were interviewed.

In connection with this work information was obtained for plotting on charts various landmarks and other aids to navigation existing along the portions of the coast visited.

Apparatus for current observations was installed on two light vessels, at Southwest Pass and Heald Bank, and later an inspection was made of the apparatus and the method of making these observations. Facilities for this work were afforded by the lighthouse inspector of the eighth district.

Changes and repairs to the tide station at Galveston were made, a new bench mark was established, and levels were run between the tide gauge and the old and new bench marks.

Various Government officials were consulted as to the unit of soundings desirable on charts of the 1:80,000 scale.

GEORGIA AND FLORIDA.

[J. S. BILBY.]

SUMMARY OF RESULTS.—Triangulation: 54 signal poles erected for traverse and triangulation, 12 hydrographic signals erected, average height 75 feet, 52 stations in main scheme occupied for horizontal measures.

In January instructions were issued for the erection of hydrographic signals on the coast of Georgia and Florida for the use of the party on the Coast and Geodetic Survey steamer *Bache* engaged in offshore hydrographic surveys between St. Simons Island, Ga., and Matanzas Inlet, Fla.

After selecting sites for the signals on Jekyl and Cumberland Islands and making arrangements for the transportation of material, field work was begun on Jekyl Island on January 13. The first signal was built on Jekyl Island and its position was determined. The work was then continued southward, signals were built, and their positions determined as far as Matanzas Inlet, Fla.

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In all, 12 hydrographic signals were built ranging in height from 68 to 86 feet, the average height being 75 feet above the station mark. The position of each signal was determined by triangulation or traverse, and a permanent mark was placed at each signal. During the progress of the work the building of signals and location of points were carried along together. Photographs and descriptions of the signals were transmitted to the office at Washington.

All necessary signals were built and their positions determined by March 27 and work was closed on March 30.

These signals are an innovation and decided advancement in this class of hydrographic work, enabling accurate development to be carried much farther seaward than otherwise possible in a region without natural elevations. The design and construction of the signals were by the builder, and the method of having an inexpensive shore party to erect them greatly facilitated the prosecution of the work by the *Bache*.

FLORIDA.

[N. H. HECK.]

SUMMARY OF RESULTS.—Leveling: 3.5 miles of levels run. Hydrography: 10.8 square miles of area dragged, 47 miles run while dragging, 2,813 angles measured, 238 soundings made, 1 tide station established, 1 hydrographic sheet finished, scale 1:20,000.

Wire-drag work was begun at Key West, Fla., on January 6. The work to be done included an examination of the west channel from the limits of previous work south of Man Key for a distance of 10 miles to a point south of the eastern side of Marquesas Keys, with a width of 1 mile; also such small areas unfinished in the work of the previous season as could be dragged without interfering with the work first named.

It was desired to drag the most doubtful remaining part of the channel from Key West to Dry Tortugas. This channel is used regularly by a naval tug and by the lighthouse tenders, but is very little used by commercial vessels. This is partly due to the well-established belief that no undragged area is safe. As soon as sufficient width had been dragged to make the channel safe for navigation the work was to be closed.

There were several practically new features in this work. The original survey was not sufficiently close for control of the wire-drag work, and a day had to be spent in sounding over undeveloped spaces. The area to be examined lies from 10 to 20 miles from Key West. There is a good boat harbor with an entrance depth of 7 feet within 3 and 7 miles, respectively, of the ends of the working ground at Boca Grande Key. In order to use this it was necessary to put down a heavy mooring, as the use of anchors would cause delay each day. The launches were barely large enough to carry the party and provide very inadequate living accommodations. Boca Grande is without fresh water or other facilities for camping.

The plan was adopted of having all work of assembling and repairing the drag done at Key West, as well as the office work. The drag party was required to have on hand a two days' supply of provisions and the necessary equipment for catching fish. Whenever at the

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close of a day the weather prospects appeared favorable, the party remained at Boca Grande and was ready for an early start next morning. The weather conditions were usually unfavorable and high winds prevailed during much of the time.

No triangulation, topography, or signal building was necessary, although several signals had to be repaired. The signals built by the party on the steamer *Bache* were found to be in good condition.

An area of 10.8 square miles was dragged and 100 shoals were found. Instead of the indicated safe depth of 28 feet, a maximum safe depth of 22 feet when using great care is available. About 5 square miles of the area is entirely obstructed. Vessels using care to keep in the dragged area and drawing not more than 18 feet are safe.

Owing to the nature of the locality and the existence of so many obstructions the cost of the work was greater than in similar work elsewhere.

No changes were made in the drag during the season. A new signal system was installed and a new apparatus which had been designed and built during the preceding season was put in operation. A new tripping device received at the beginning of the season was used with satisfactory results. The hired launches proved satisfactory.

An inspection was made of the automatic tide gauges at Key West, St. Augustine, and Fernandina.

Pacific Coast.

WASHINGTON.

[G. T. Rude.]

On January 21 apparatus for current observations was installed on lightship *No. 88*, off the mouth of the Columbia River. This apparatus was inspected on March 6. On March 7 current apparatus was installed on Umatilla Reef Light Vessel at Portland, Oreg.

In March triangulation work was begun to connect the Lake Washington triangulation of 1914 with that by the Coast and Geodetic Survey and that by the Army Engineers along Lake Union and Salmon Bay. Many of the stations in this work were on the tops of buildings and were marked by drill holes in the walls or in some other permanent manner. This work was completed on April 23. All stations on the ground were marked with regulation disk triangulation station marks and the usual reference marks were placed. The work was started from stations Brush, Golf, and Cross of the 1914 work and carried across Portage Bay to Union Bay, connecting with station Army, a United States Army Engineers monument on the Washington Boulevard near Union Bay. This scheme connects with the triangulation of 1913 by E. E. Smith, of the Coast and Geodetic Survey, and also with other stations of the Army Engineers. The work was extended from Lake Union through Ross Valley and down Salmon Bay to the Sound, following the whole course of the Lake Washington Canal, then in course of construction. A reconnoissance was made with a view to extending the work down the valley.

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In March an inspection was made of the apparatus for current observations installed on the Columbia River Light Vessel. Transportation was furnished by the lighthouse tender *Manzanita*. The observations were being made in accordance with directions given when the apparatus was installed in January.

Current apparatus was afterwards installed on the Umatilla Light Vessel and the officers in charge were instructed as to the method of making the observations. These observations are being made with the cooperation of the Bureau of Lighthouses.

[C. G. QUILLIAN, Commanding Steamer *McArthur*.]

SUMMARY OF RESULTS.—Triangulation: 24.6 square miles of area covered, 25 stations occupied for horizontal measures, 42 geographic positions determined, 4 old stations recovered, 15 new stations occupied and marked.

A revision of the triangulation and topography of Rich's Passage and Port Orchard, Wash., was made in March and April, 1915.

Some of the stations of the old triangulation were recovered to serve as a base for the revision work, and a sufficient number of new stations were established for the control of the shore line. All old stations recovered were connected with the main scheme of the new work and re-marked.

The triangulation was extended from the base Orchard-Restoration to the vicinity of station Harper through two quadrilaterals. This carried it through Rich's Passage and up Port Orchard to Battle Point.

The shore line was rerun and all improvements such as buildings, wharves, and other features which are of value on a chart were added to the topographic sheets. No contours were run.

The shore line was surveyed from the settlement of Manchester to Waterman on the south shore of Rich's Passage, and from Restoration Point to Battle Point on Bainbridge Island, and from Enetia settlement to Brownsville on the west shore of Point Orchard. The work was included on two topographic sheets on a scale of 1:10,000.

[R. S. PATTON, Commanding Steamer *Explorer*.]

WIRE-DRAG WORK.—Nine square miles of area covered, 51.6 miles run while dragging, 3,013 angles measured, 2 wire-drag sheets finished, scale 1:10,000.

On March 3, 1915, the *Explorer* took up wire-drag work in Rich's Passage, Wash., continuing on this work until April 22, when it was suspended on account of the necessity of repairing and outfitting for the summer's work in Alaska.

[H. C. DENSON, Commanding Steamer *Patterson*.]

April 1 the *Patterson* was undergoing general repairs at the Puget Sound Navy Yard and remained there until April 29, on which date all work was completed. The vessel then proceeded to Eliott Bay and coaled.

From May 1 to May 15 the vessel was at quarantine station and Port Townsend, where a thorough fumigation and cleansing of the ship was completed. While this work was in progress a survey of the approaches to the canal between Port Townsend Bay and Oak Bay was made, and the vessel then returned to Seattle to outfit for the Alaskan season. On May 30 the *Patterson* left Seattle for the

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Shumagin Islands via Port Townsend, where a stop of three days was made to do some additional work in Port Townsend Bay.

[F. H. HARDY, Commanding Steamer *Gedney*.]

SUMMARY OF RESULTS.—Triangulation: 14.5 square miles of area covered, 19 signal poles erected, 19 stations in main scheme occupied for horizontal measures, 19 geographic positions determined. Topography: 2.8 square miles of area surveyed, 15.1 miles of general coast line surveyed, 10.9 miles of shore line of ponds surveyed, 2 topographic sheets finished, scales 1:10,000 and 1:5,000. Hydrography: 10 square miles of area surveyed, 6.3 miles run while sounding, 338 angles measured, 906 soundings made, 1 hydrographic sheet partly finished, scale 1:10,000.

On March 1, 1915, the *Gedney* left Seattle and began revision work in Liberty (Dogfish) Bay on Puget Sound. The triangulation was extended from the line joining the stations Jackman-Rock of 1880 to the head of the bay. A topographic survey was made of the shore line and soundings were made around the docks.

On March 16 the vessel was taken to the navy yard. While there the triangulation of Port Orchard from the limits of the work by the steamer *McArthur* to the head of the bay was completed.

OREGON.

[J. W. MAUPIN.]

SUMMARY OF RESULTS.—Base lines: 1 secondary 600 meters in length. Triangulation: 10 square miles of area covered, 92 signal poles erected, 60 stations in main scheme occupied for horizontal measures, 1 station in supplemental scheme occupied for horizontal measures, 118 geographic positions determined. Topography: 13 square miles of area surveyed, 7 miles of general coast line surveyed, 26 miles of shore line of rivers surveyed, 2 topographic sheets finished, scale 1:10,000. Hydrography: 20 square miles of area covered, 297.3 miles run while sounding, 3,167 angles measured, 10,854 soundings made, 2 tide stations established, 1 current station occupied, 2 hydrographic sheets finished, scale 1:10,000.

The resurvey of Yaquina Bay, begun in June, was in progress at the beginning of the fiscal year, by which time a triangulation scheme had been laid out and the stations permanently marked.

In July a base line was laid out and measured and the signal building and the observation of angles begun. It was found necessary to carry a continuous scheme of triangulation along the shores of the river from the entrance of Yaquina Bay to the town of Toledo, and owing to the narrowness of the river short lines were used, in some cases less than 200 meters in length. Several stations had to be established on the mud flats and this necessitated the construction of eight platforms as stands for the observer. The lines of sight being so short very accurate methods were used in erecting the signals and great care taken in making the observations. A launch was hired for the outside hydrography on the bar and reefs, and advantage was taken of every day on which work could be done on the bar but these were very few. At the same time the topographic work was being carried on. Much of the old shore line had to be rerun, and the work back from the shore on one of the old topographic sheets had to be done over, owing to changes that had occurred since the former survey.

The inside hydrography was continued in conjunction with the other work. In order to establish the existence of a 10-foot channel

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rocks near the beach. The area dragged extends to a line about 2½ nautical miles south of Walden Rocks.

In Revillagigedo Channel the shore line was not approached so closely as in the narrower channels, the object being more to insure the safety of the main fairways rather than to locate rocks near the beach line. In this region the area was covered more rapidly than in Tongass Narrows. It was demonstrated here that very rapid progress can be made in wide channels, generally clear, but with occasional pinnacle rocks. In this channel the work was extended to a line from Twin Islands to Alava Point, including the passage north of Bold Island and Thorne Arm for a distance of about 2½ nautical miles.

The survey in Port Chester was to verify shoal soundings near the entrance to the harbor discovered by the party on the steamer *McArthur* in the progress of a regular hydrographic survey. A thorough examination of the harbor and entrance was made, the examined area extending from abreast Cedar Point to within half a mile of Driest Point and east of Warbuton Island and Kelp Rocks buoy. The entire survey was made in four working days.

The experience gained in this season shows that kelp is not a serious obstacle to wire-drag work, but the drag can not be towed over kelp against the tidal current.

In Tongass Narrows two new wharves in Ward Cove and three uncharted wharves at Ketchikan were located. In Revillagigedo Channel the shore line was carefully sketched in and one day's work with the plane table was done near the entrance to Thorne Arm.

Two tide stations were established, one at Ward Cove and the other at Hassler Harbor, and observations were made on staff gauges. Automatic gauges were maintained during the season at Ketchikan and Metlakatla. At the latter place 10-minute observations were taken upon the staff during the hours when work was being done.

During the season 21 dangers were discovered of importance to navigators in Tongass Narrows, Nichols Passage, Revillagigedo Channel, and Port Chester. Of these the most important were a 7-foot pinnacle rock off Vallenar Point, in Tongass Narrows; a 19-foot pinnacle rock near the north shore; a 3-foot pinnacle rock near East Clump Light; a 26-foot pinnacle rock near the New England Fish Co.'s dock. In Revillagigedo Channel a 13-foot pinnacle rock near Spire Island Light; a 5-foot rocky patch in same locality; a 26-foot rocky patch in the entrance to Hassler Harbor; a 15-foot pinnacle rock in the same locality; a 17-foot pinnacle rock near the entrance to Thorne Arm; and a sounding of 26 feet off Hog Rocks. In Port Chester a 10½-foot sounding on shoal near Kelp Rocks Buoy discovered by steamer *McArthur*.

Wire-drag work was resumed May 12, 1915, in Revillagigedo Channel southeast of Ketchikan from the limits of the 1914 work to the British Columbia boundary line. A tide gauge was established at Hassler Harbor and later on one at Kah Shakes Cove in the entrance to Boca de Quadra.

From May 11 to the end of the fiscal year dragging was in progress whenever the weather permitted. On June 21 reconnoissance and signal building were begun in Clarence Strait.

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The work of collating the work of the field topographers and hydrographers in order to produce the charts needed for the use of navigators was continued. After the completion of the drawings for such charts, they are very carefully verified and are then traced and the tracings are sent to Washington, where they are reproduced by lithography and issued for sale.

The collection and preparation for publication of all kinds of nautical information and the issue of charts and nautical almanacs was continued.

The collection, compilation, and preparation for publication of all manner of topographic information concerning the interior of the islands were continued in the geographical division. The several maps already published have thus far found ready sale at the established price of ₱1 each.

[O. W. SWAINSON, Commanding Steamer *Research*.]

SUMMARY OF RESULTS.—Reconnoissance: 336 square miles of area covered, length of scheme 18 miles, 9 lines of intervisibility determined, 5 points selected for scheme. Triangulation: 330 square miles of area covered, 23 signal poles erected, 2 observing tripods and scaffolds built 34 feet in height, 5 stations in main scheme and 3 stations in supplemental schemes occupied for horizontal measures, 5 stations occupied for vertical measures, 25 geographic positions determined. Topography: 136 square miles of area surveyed, 176 mies of general coast line surveyed, 25 miles of shore line of rivers and creeks surveyed; 6 topographic sheets finished, scales 1:10,000 and 1:20,000. Hydrography: 456 square miles of area covered, 1,763 miles run while sounding, 5,043 angles measured, 21,167 soundings made, 1 tide station established; 3 hydrographic sheets finished, scales 1:20,000 and 1:40,000.

From January 1 to March 16 the steamer *Research* was undergoing repairs and outfitting at Manila. On the afternoon of March 16 the vessel left Manila for the working ground in the vicinity of Sorsogon Bay and to the northward, stopping at Port San Miguel, Ticao Island, to inspect the automatic tide gauge established there during the previous season.

Upon arrival at the entrance to Sorsogon Bay signals were at once erected and the topography begun. The work here was well controlled by numerous triangulation stations occupied during the previous season. From these stations nearly all of the hydrographic signals were cut in. By May 15 the topography was completed as far north as Dumaquit Point. It was then taken up on the west side of the south end of Ticao Island and continued northward.

Two main-scheme triangulation stations, Dulan and Cabrian, the secondary stations necessary for the topography along the Luzon coast from Donsol to Cabarian Point and from the south end of Burias Island to Claveria, were established. Intersection stations were placed from 2 to 4 miles apart on both Luzon Island and Burias Island. Heliotropes were used on the lines Enganso-Donsol and Sagurun-Donsol. When the triangulation was finished the topography was continued and the hydrographic work begun.

The hydrography of the entrance to Sorsogon Bay and all of Ports Panlatuan and Putiao as far offshore as the 20-fathom curve was done by the launch party. The rest of the hydrography was done with the ship.

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Certificates of Inspection Issued to Steam, Sail, and Motor Vessels and to Barges During the Fiscal Year Ended June 3 1915, by Districts.

Supervising district.	Local district.	Domestic vessels.												Foreign passenger steam vessels.		Total.	
		Steam vessels.		Motor vessels.		Passenger sail vessels.		Passenger barges.		Seagoing barges.		Total.					
		Number.	Gross tonnage.	Number.	Gross tonnage.	Number.	Gross tonnage.	Number.	Gross tonnage.	Number.	Gross tonnage.	Number.	Gross tonnage.	Number.	Gross tonnage.	Number.	Gross tonnage
First....	San Francisco, Cal.	341	463,020	65	4,943	1	1,097	1	126	6	12,140	414	481,326	10	44,610	424	525,
	Honolulu, Hawaii	24	11,273	7	347					1	913	32	12,533	7	70,784	39	83,
	Juneau, Alaska	46	3,007	10	404							56	3,411			56	3,
	Los Angeles, Cal.	19	15,615	19	970							38	16,585	4	25,256	42	41,
	Portland, Oreg.	134	46,345	28	2,186					1	375	163	48,906			163	48,
	St. Michael, Alaska	22	8,718	2	62							24	8,780	4	3,619	28	12,
	Seattle, Wash.	266	153,174	33	3,723					18	21,419	317	178,316	37	204,673	354	382,
Second..	New York, N. Y.	1,244	988,279	54	1,741			9	2,484	153	155,604	1,460	1,148,108	146	1,324,417	1,606	2,472,
	Albany, N. Y.	162	59,207					1	275			163	59,482			163	59,
	New Haven, Conn.	80	11,101	43	1,556					1	472	124	13,129			124	13,
	Philadelphia, Pa.	274	182,933	30	1,480					96	87,584	400	271,997	11	77,478	411	349,
Third...	Norfolk, Va.	194	100,128	43	1,040			2	620	82	55,402	321	157,190			321	157,
	Baltimore, Md.	263	161,233	43	2,024					30	25,415	336	188,672	4	32,851	340	221,
	Charleston, S. C.	71	9,199	18	531			1	40	4	3,278	94	13,048			94	13,
	Jacksonville, Fla.	42	11,360	33	1,087					5	3,865	80	16,312	1	73	81	16,
	Savannah, Ga.	46	33,712	5	871					1	2,944	52	37,527			52	37,
Fourth..	St. Louis, Mo.	93	16,522	18	426							111	16,948			111	16,
	Dubuque, Iowa	48	4,475	35	1,414			3	657			86	6,546	4	1,586	90	8,
Fifth....	Boston, Mass.	208	148,544	4	109					66	65,569	278	214,222	18	144,771	296	358,
	Bangor, Me.	62	12,670	8	241					7	7,512	77	20,423	1	127	78	20,
	New London, Conn.	63	21,700	13	405					4	2,999	80	25,104			80	25,
	Portland, Me.	60	22,672	3	62					15	8,643	78	31,377	3	28,051	81	59,
	Providence, R. I.	102	80,276	10	276					29	40,357	141	120,909			141	120,
Sixth....	Louisville, Ky.	37	5,278	8	507							45	5,785			45	5,
	Evansville, Ind.	48	9,722	2	135							50	9,857			50	9,
	Memphis, Tenn.	51	7,808	5	129							56	7,937			56	7,
	Nashville, Tenn.	69	10,465					1	397			70	10,862			70	10,
Seventh.	Pittsburgh, Pa.	98	17,211	1	22							99	17,233			99	17,
	Cincinnati, Ohio.	44	9,440									44	9,440			44	9,
	Point Pleasant, W. Va.	51	7,008	3	66							54	7,074			54	7,
Eighth..	Detroit, Mich.	102	110,463	5	103							107	110,626	5	6,444	112	117,
	Chicago, Ill.	143	270,563	9	566							152	271,129			152	271,
	Duluth, Minn.	105	302,525	4	98							109	302,623			109	302,
	Grand Haven, Mich.	78	50,937	10	332							88	51,269			88	51,
	Marquette, Mich.	31	7,808	1	28			1	148			33	7,984	2	517	35	8,
	Milwaukee, Wis.	103	299,385	6	480							160	299,865			160	299,
	Port Huron, Mich.	60	46,634									60	46,634	7	18,788	67	65,

this Bureau. Under the provisions of section 4417, Revised Statutes, the local inspectors are required, once in every year at least, to carefully inspect the hull of each steam vessel within their respective districts, and satisfy themselves that every such vessel so submitted to their inspection is of a structure suitable for the service in which she is to be employed, etc. Under authority conferred by this statute the local inspectors have the right to refuse to certificate a vessel they do not believe is of suitable structure. Nevertheless it has never been held that the Board of Supervising Inspectors has authority to lay down in detail structural tests in the same manner as has been done in the case of boiler construction, express authority in the case of boilers having been conferred by certain statutes applicable thereto. It may be interesting to review in this connection certain remarks and recommendations that have been made by this office in previous annual reports in regard to hull inspection.

Attention is called to the remarks under the heading "Hull inspection," appearing on page 15[a] of the annual report of the Supervising Inspector General for the fiscal year ended June 30, 1910, which read as follows:

> For some time it has been required that the manufacturers of boilers submit to the local inspectors blue prints showing in detail the proposed construction of the boiler or boilers which they are about to build. Inspectors have thereby been enabled to ascertain whether the boilers are to be constructed in conformity with the requirements of the General Rules and Regulations and of the United States statutes upon which those rules and regulations are based, and before approving such blue prints they frequently confer with the boiler manufacturers and point out to them the defects, if any.
>
> This Service is of opinion that the time has now come when blue prints of hull construction should also be submitted, not with a view to imposing unnecessary burdens upon shipbuilders and the owners of steam vessels, but in order that the inspectors may know whether the hulls of the vessels proposed to be built are to be constructed in accordance with safe practice. At present the inspectors of hulls ascertain exactly whether the necessary life-saving and fire-fighting equipment is aboard the boat, whether the fire hose is in a good condition, whether the necessary life preservers are on board and in good condition, and other matters relating to the hull inspection of a vessel, but having ascertained all of this they are often still in ignorance as to the details of the original construction of the hull.
>
> An important item of information with which inspectors should be furnished when the hull of a steamer is built is the thickness of the material and the size and weight of the scantling used in the construction thereof, for it is well known that there is a general deterioration of hulls, with the result that as the years go by and the vessels go from one district to another the inspectors really have to depend absolutely upon surface indications as to the condition of the hull. The condition of a steel or iron hull is ascertained by the hammer test and general indications, and of wooden hulls by boring, scraping, etc. Anyone familiar with hull construction knows that quantities of rust accumulate on the inside of the iron or steel hull, if not properly cared for, with the result that each year the material of such a hull becomes thinner, while the wooden hull softens and rots. If inspectors were furnished with detailed information regarding the original construction of a hull, they would then be accurately informed as to just how much the vessel had deteriorated since her construction. It is therefore proposed to submit to you for approval a bill which will make necessary a more detailed hull inspection than that heretofore prevailing.

While it was stated in the last sentence of the above quotation that it was proposed to submit to you a bill that would make necessary a more detailed hull inspection than that heretofore prevailing, it was finally decided when the matter came before the Board of Supervising Inspectors for consideration that the first steps to be taken in this respect might better be in the form of a regulation

[a] Refers to pagination in separate report.

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Ports visited.	Stations inspected.				Operators ex	
	Ship.	Commercial and special land.	General and restricted amateur.	Total.	Commercial.	Amat and s cia
Seventh district:						
SEATTLE, WASH.	353	6	16	375	89	
Bellingham, Wash.	1	.....	1	2	.....	.....
Portland, Oreg.	2	1	24	27	.....	.....
Salem, Oreg.	.....	.....	6	6	.....	.....
Silverton, Oreg.	.....	.....	3	3	.....	.....
Total.....1915..	356	7	50	413	89	
1914..	702	2	.....	704	36	
Eighth district:						
CLEVELAND, OHIO	97	4	2	103	112	
Akron, Ohio	.....	1	.....	1	.....	.....
Ashtabula, Ohio	3	1	.....	4	.....	
Benton Harbor, Mich.	.....	2	.....	2	.....	.....
Buffalo, N. Y.	8	2	.....	10	6	
Canton, Ohio	.....	1	.....	1	.....	.....
Cincinnati, Ohio	.....	.....	2	2	2	
Conneaut, Ohio	5	.....	.....	5	.....	
Detroit, Mich.	14	3	.....	17	1	
Frankfort, Mich.	5	2	.....	7	.....	
Grand Haven, Mich.	.....	2	.....	2	.....	
Grand Rapids, Mich.	.....	1	.....	1	3	
Hamilton, Ohio	.....	.....	1	1	.....	
Ludington, Mich.	6	2	.....	8	.....	.....
Warren, Ohio	.....	1	.....	1	.....	.....
Wheeling, W. Va.	.....	1	.....	1	.....	
Total.....1915..	138	23	5	166	124	6
1914..	139	18	2	159	161	3
Ninth District:						
CHICAGO, ILL.	76	4	.....	80	113	5
Calumet, Mich.	.....	1	.....	1	.....	.....
Duluth, Minn.	3	1	.....	4	.....	.....
Grand Marais, Minn.	.....	1	.....	1	.....	.....
Illiopolis, Ill.	.....	1	.....	1	2	.....
Indianapolis, Ind.	.....	.....	.....	.....	1	
Mackinac Island, Mich.	2	2	.....	4	.....	.....
Manistique, Mich.	.....	2	.....	2	.....	.....
Manitowoc, Wis.	2	1	.....	3	.....	.....
Milwaukee, Wis.	1	1	.....	2	.....	.....
Springfield, Ill.	.....	1	.....	1	.....	.....
St. Louis, Mo.	.....	2	2	4	3	
Valparaiso, Ind.	.....	.....	.....	.....	43	.....
Total.....1915..	84	17	2	103	162	5
1914..	63	8	5	76	71	6
Grand total.....1915..	6,152	122	438	6,712	944	2,25
1914..	6,486	129	239	6,854	1,306	93

The Bureau has begun to assemble records of marine cas in which the wireless system on ships inspected by the Depa contributed to the saving of life and property. Incomplete r for the past fiscal year show 36 such casualties and in every in the apparatus worked satisfactorily, the auxiliary set taking work of the communication when the main set, through the na the casualty, was put out of commission. Radio operators h for themselves high standards of courage and devotion to duty

If the pressure of business before Congress will permit, legisla desirable to bring our laws in a few particulars into fuller accord w provisions of the London International Radiotelegraphic Conv The regulation of the rentals charged for radio apparatus on shi

The work of preventing the overcrowding of vessels is important and the Department, in order to secure the best men available, requested the Civil Service Commission to hold a special examination for the purpose. The employment of these inspectors is for the summer months only and many students in the colleges and schools of the country passed the examination. We thus have available a force of bright, energetic young men who appreciate the seriousness of the work they have undertaken. The examination was of a nature which enables these navigation inspectors after two years' service to be transferred to any other position in the Government. This made the register attractive and will enable the Bureau to draw from it in future trained men for work in the various navigation branches.

WORK OF SHIPPING COMMISSIONERS.

Summaries of the work of shipping commissioners for the past fiscal year are printed in Appendix A. The total number of seamen shipped, reshipped, and discharged by these offices, maintained at 15 ports, was 414,744, compared with 378,772 during the previous fiscal year. The increase is attributable almost wholly to the ship registry act, New York increasing from 204,347 to 247,833, New Orleans from 11,566 to 27,687, and Seattle from 49,467 to 52,263, while San Francisco decreased from 54,378 to 29,285. The cost of salaries was $63,755.47, an increase of only $280.27. To carry out the increased amount of work, especially at New York and New Orleans, it has been necessary to secure the temporary detail of clerks from the customhouses. The increase of work at these two ports was anticipated last year and provision for two more clerks was included in the estimates without result. A small increase in the clerical force of these offices is needed if the work is to be kept up, and has been provided for again in the estimates.

The following summary shows the aggregate routine work and salaries of shipping commissioners and deputies for the past decade:

Year.	Seamen shipped, reshipped, and discharged.	Salaries.	Average cost per man.	Year.	Seamen shipped, reshipped, and discharged.	Salaries.	Average cost per man.
1906	227,392	$60,595.23	$0.26	1911	367,023	$67,155.90	$0.18
1907	259,570	61,716.60	.24	1912	374,783	63,373.53	.17
1908	307,299	63,585.16	.21	1913	379,188	62,374.13	.16
1909	341,980	62,944.79	.18	1914	378,772	63,475.20	.17
1910	356,448	65,539.19	.18	1915	414,744	63,755.47	.15

The shipping commissioners' offices at Pascagoula, Miss., Bath, Me., and Gloucester, Mass., were discontinued on July 1, 1915, as Congress saw fit to make no provision for the maintenance of these offices. The work has been taken over by collectors of customs at these ports, as provided in section 4503 of the Revised Statutes. During the past fiscal year collectors and deputy collectors of customs at 55 seaports, pursuant to this section, shipped and discharged 11,532 seamen. At Port San Luis, Cal., 1,163 were shipped and discharged; at Newport News, Va., 1,152; at Portland, Oreg., 1,121; and at San Diego, Cal., 1,118. The great growth of shipping business at Norfolk and Newport News during the past year, if maintained

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shipping commissioner's o

Up to July 28, 1864, th
States were required to be
tion, however, was remov
ure, and since that time t
act as members of the cr
ception, however, is to be
prescribes that ships unde
for carrying the mails pu
fourth of whom during t
during the next three yea
contract, must be citizen
does not limit the crews o
The laws of France and F
their merchant vessels, re
subjects, and the laws of
Norwegian merchant vess
nationality of the men co
vessels may be derived fr
ality of the men shipped
by shipping commissioner
past seven years:

Nationality.	190
Americans (born)	58,6
Americans (naturalized)	31,0
British	21,5
Chinese	1
Japanese	6
Filipinos	1
Germans	6,1
Norwegians	9,0
Swedes	6,5
Danes	2,2
Russians	3,7
Austrians	1,5
French	7
Spanish	23,3
Italians	3,5
Portuguese	*3,9
Others	7,8
Unknown	
Total	180,9
Per cent Americans	49

The men covered in the
tween men on salt-water
trade. These figures, it
218,541 individual seame
several voyages before shi
times in the tabulation.
ing the proportion of diffe

The crews of American
and sounds of the seaboar
voyages, are not shipped
appear in the figures ab

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consul in a foreign port for one or more round voyages to that port. Occasionally one or more members of a crew are shipped before a consul in a foreign port as substitutes for men who are discharged or desert. Such seamen are not included in the table above, and by far the larger part of them are aliens, as relatively few American seamen are to be found in foreign ports. During the year ended June 30, 1915, 21,209 seamen were thus shipped abroad, of whom 6,312 were shipped before consuls in Asia, and of these by far the greater part were Asiatics.

DESERTION OF SEAMEN.

The law providing for the arrest for desertion of seamen from American vessels in Europe, Asia, Africa, Australia, and South America, as has been stated in previous reports, has long been an empty form on the statute books, as the power bestowed is almost never invoked. This law was repealed by section 8 of the seamen's act of March 4, 1915, and after November 4, 1915, arrests for desertion of seamen from American vessels will cease. The same act provided for the termination of articles in treaties and conventions for the arrest of officers and seamen deserting from foreign merchant vessels in ports of the United States, and the necessary notifications to foreign Governments of the termination of treaty provisions on this subject to take effect July 1, 1916, have been given. The percentage of seamen who failed to report on board after having signed articles before shipping commissioners in ports of the United States for the past 10 years is shown by the following table:

Year.	Shipped and re-shipped.	Failed to join.	Per cent.	Year.	Shipped and re-shipped.	Failed to join.	Per cent.
1906	126,745	3,894	3.07	1911	192,191	3,062	1.60
1907	143,399	4,007	2.79	1912	198,225	3,849	1.94
1908	163,192	3,101	1.90	1913	198,024	3,906	1.97
1909	181,032	2,114	1.17	1914	199,584	2,771	1.39
1910	185,721	2,690	1.45	1915	218,541	3,339	1.53

ALLOTMENT NOTES.

The following table shows the number of allotment notes issued in recent years under section 24 of the act of December 21, 1898, to seamen on vessels of the United States:

Year.	Creditors.		Relatives.	Total.
	Square-rigged.	All other vessels.		
1903	2,005	1,870	284	4,159
1904	1,966	1,513	287	3,766
1905	1,595	919	304	2,818
1906	1,492	421	309	2,222
1907	1,323	490	239	2,052
1908	967	393	133	1,493
1909	660	114	84	858
1910	631	145	79	905
1911	505	241	57	803
1912	555	296	62	913
1913	419	135	64	618
1914	257	279	166	702
1915	400	595	682	1,677

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siderable space, and the difference between the gross and net tonnage will, of course, be considerable. In the case of trans-Atlantic passenger steamers of high speed, powerful machinery, and many auxiliaries, consuming large quantities of coal, a very large part of the cubical contents of the ship must be deducted from the gross tonnage, reducing proportionately the net tonnage.

The net or earning capacity of a ship is the basis upon which most Government charges on shipping are levied, although this rule is not universal. This net tonnage is also called the register tonnage and is the basis used by maritime countries in their statistics showing the entries and clearances of vessels.

The Moorsom system for ascertaining gross tonnage was adopted in the United States by the act of March 6, 1864. Up to August 5, 1882, the laws of the United States contained no provision for the deduction of propelling power and other spaces not available for cargo and passengers. This omission was remedied by the act of March 5, 1882, which provided for certain deductions from the gross tonnage, in order to establish the net tonnage. As already indicated, the propelling power and the bunker coal of a steamer occupy considerable space. The space actually occupied by bunker coal obviously may vary materially, according to the length of the voyage and the amount of coal which must be carried. At the same time it is clearly desirable to make an allowance once for all for this variable factor.

Two rules have long been in use for determining the allowance to be made for propelling power and fuel, one known as the Danube rule, the other as the British or Board of Trade rule. These two rules, and in fact the entire subject of measurement of vessels, were considered at some length in the report of this Bureau for 1911 (pp. 24–42[a]). Without going into details, the Danube rule in the case of most ships makes a smaller allowance for propelling power, including fuel, than does the British rule. The Danube rule has been adopted by the administrations of the Panama and Suez Canals. The British rule, however, is in general use at this time by maritime nations. Our measurement act of 1882 adopted the Danube rule and accordingly American steamers were at some disadvantage as compared with the steamers of most maritime powers in the matter of measurement. The Frye Measurement Act of March 2, 1895, adopted for the United States the British rules for measuring propelling power and in other respects brought our law into accord with prevalent maritime practice. Administrative officers, however, in different countries, or in the same country, have not always put the same construction upon usual words in the vocabulary of marine architecture, such as "upper deck," "permanent closed-in space," "sheltered spaces," "under cover," and "open to the weather." These differences of interpretation have arisen mainly in vessels with "shelter decks."

During the seventies it was the practice to carry cattle, exported from this country, in temporary wooden stalls on the upper deck, with wooden and canvas screens and awnings, a system involving at times suffering and loss to the cattle and risk to the cattle attendants, as well as high insurance and high freight rates. In the course of a short time the steel sides of the ship were carried up to a level with the top of the forecastle and the bridge house and the space covered

[a] Refers to pagination in separate report of Commissioner of Navigation.

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OFFICE OF THE SECRETARY—Continued.

Title and description.	Pages.	Edition.	Cost.
Letter requesting that item of legislation be inserted in any appropriation bill reported from Committee on Appropriations during present session of Congress authorizing employment of personal services in District of Columbia and in field in service of Bureau of Standards. Aug. 6, 1914. [Printed as H. doc. 1139, 63d Cong. 2d sess.] 8vo	3	(a)	$5.72
Letter suggesting amendments to H. R. 9017 transferring control and jurisdiction of Alcatraz Island and buildings thereon from Department of War to Department of Labor. Sept. 19, 1914. [Printed as H. doc. 1164, 63d Cong. 2d sess.] 8vo	3	(a)	6.57
Letter transmitting draft of bill to amend sections 4404 and 4405, Revised Statutes, to provide for 11 instead of 10 supervising inspectors in Steamboat-Inspection Service and striking out provision in section 4405 that supervising inspector on Pacific coast shall not be under obligation to attend meetings of board of supervising inspectors of steam vessels oftener than once in 2 years. Oct. 10, 1914. [Printed as H. doc. 1173, 63d Cong. 2d sess.] 8vo	2	(a)	3.14
Item of legislation to authorize Secretary of Commerce to transfer portion of lighthouse reservation, Tawas, Mich., to Secretary of Treasury. Dec. 8, 1914. [Printed as H. doc. 1206, 63d Cong. 3d sess.] 8vo	2	(a)	4.38
Statement regarding purchase of typewriting machines for first 3 months of fiscal year 1915. Dec. 8, 1914. [Printed as H. doc. 1209, 63d Cong. 3d sess.] 8vo	2	(a)	10.52
Letters from captains and pilots of Pacific Coast Steamship Co., Alaska Steamship Co., and Pacific-Alaska Navigation Co., urging necessity of providing equipment for surveys of coast of Alaska, and recommendations and references from annual report for fiscal year 1914. Dec. 8, 1914. [Printed as H. doc. 1214, 63d Cong. 3d sess.] 8vo	32	(a)	84.11
Statement of claims for damages which have been considered, adjusted, and determined by Commissioner of Lighthouses. Dec. 9, 1914. [Printed as H. doc. 1281, 63d Cong. 3d sess.] 8vo	2	(a)	.....
Detailed statements of disbursements by Department of Commerce and Labor for 1913 and 1914 and Department of Commerce for 1914. Dec. 11, 1914. [Printed as H. doc. 1339, 63d Cong. 3d sess.] 8vo	92	(a)	644.05
Claims covering amounts due for damages to private property by accidents in connection with work of Coast and Geodetic Survey. Dec. 12, 1914. [Printed as H. doc. 1349, 63d Cong. 3d sess.] 8vo	9	(a)	27.80
Urgent estimates of appropriation for inclusion in urgent deficiency bill for fiscal year 1915. Dec. 16, 1914. [Printed as H. doc. 1364, 63d Cong. 3d sess.] 8vo	5	(a)	14.66
Statement of expenditures in Coast and Geodetic Survey, fiscal year 1914. Dec. 21, 1914. [Printed as H. doc. 1424, 63d Cong. 3d sess.] 8vo	16	(a)	119.41
Estimate of appropriation for clerk to Deputy Commissioner of Fisheries, fiscal year 1916. Dec. 23, 1914. [Printed as H. doc. 1432, 63d Cong. 3d sess.] 8vo	2	(a)	4.38
Estimate of appropriation for promotion of export trade. Jan. 2, 1915. [Printed as H. doc. 1470, 63d Cong. 3d sess.] 8vo	3	(a)	6.06
List of documents and files of no use in transaction of current business of Department and of no permanent or historic interest. Jan. 18, 1915. [Printed as H. doc. 1499, 63d Cong. 3d sess.] 8vo	7	(a)	18.27
Detailed statement of number of documents received and distributed by Department, calendar year 1914. Jan. 23, 1915. [Printed as H. doc. 1515, 63d Cong. 3d sess.] 8vo	8	(a)	60.66
Communication reporting claim of Central Railroad Co. of New Jersey for damage to coal dock of said company at Port Liberty, N. J., on account of damages occasioned by collision for which tender of Lighthouse Service has been found responsible, which has been considered, adjusted, and determined. Feb. 18, 1915. [Printed as H. doc. 1611, 63d Cong. 3d sess.] 8vo	2	(a)	3.65
Foreign vessels admitted to American registry under act of Dec. 23, 1852, under special acts of Congress, Hawaiian vessels, act of Apr. 30, 1900, Porto Rico vessels, act of Apr. 12, 1900, and under act of Aug. 18, 1914, prepared by E. T. Chamberlain, Commissioner of Navigation; presented by Mr. Alexander. Mar. 2, calendar day Mar. 3, 1915. [Printed as H. doc. 1664, 63d Cong. 3d sess.] 8vo	17	(a)	.....

BUREAU OF THE CENSUS.

Annual report of Director, 1914. 8vo	29	2,000	$102.19
Same [press summary]. long 4to	1	3,500	13.91
Cotton production, 1913. 15 text fig. (Bulletin 125.) 4to	79	60,000	2,963.11
Supply and distribution of cotton, year ending Aug. 31, 1914. 4 text fig. (Bulletin 128.) 4to	30	60,000	1,305.01
Same [press summary]. long 4to	1	2,000	11.91
Mortality statistics, [calendar year] 1913. 14th annual report. 4 text fig. 4to	631	6,000	12,164.56
Same [3 press summaries]. long 4to	3	8,900	33.64
Religious bodies, 1906: pt. 1, Summary and general tables. 9 text fig. (Special reports.) [Reprint.] 4to	576	1,000	772.18

a None printed for the Department.

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BUREAU OF FOREIGN AND DOMESTIC COMMERCE—Continued.

Title and description.	Pages.	Edition.	Cost.
Schedule E, classification of imports for consumption with rates of duty, and laws and regulations governing the preparation of quarterly statements; approved June 1, 1915. 8vo	112	1,000	$909.69
Commercial relations of the United States with foreign countries. Revised statistics, calendar year 1912. [Printed also as H. doc. 1452, 62d Cong. 3d sess.] 8vo	272	350	1,951.32
Important details in South American trade. [From Daily consular and trade reports of Aug. 28, 1914.] 8vo	4	6,600	22.33
Government assistance to American exporters. 16mo	8	8,000	78.72
Same [reprint]	8	12,000	72.25
Same [reprint]	8	5,000	48.50
General instructions to commercial attachés. 1914. 16mo	12	1,000	127.73

BUREAU OF LIGHTHOUSES.

Annual report of Commissioner, 1914. 8vo	102	1,500	$639.27
Same, pt. 2, Purchases in open market or by private contract, with reasons for such method of purchase, fiscal year 1914. [Printed also as H. doc. 1174, 63d Cong. 2d sess.] 8vo	39	50	281.71
Notice to mariners [issued weekly, jointly with Coast and Geodetic Survey, July 3, 1914–June 25, 1915, nos. 27–52 + 1–26, 52 numbers]. 15 charts. 8vo	938	195,225	5,395.73
Lighthouse Service bulletin [issued monthly, July, 1914–June, 1915, nos. 31–42, 12 numbers, 4 p. each]. 8vo	48	16,325	204.83
Light list, Atlantic and Gulf coasts of United States. Corrected to Jan. 1, 1915. 8vo	357	11,000	4,840.47
Same, Pacific coast, United States, Canada, Hawaiian, [Midway, Guam] and Samoan Islands. Corrected to Jan. 1, 1915. [Of the Samoan Islands only Tutuila is included in this publication.] 8vo	148	2,700	1,195.44
Same, Great Lakes, United States and Canada. Corrected to July 15, 1914. 4to	210	3,500	2,764.06
Same. Corrected to Apr. 1, 1915. 8vo	272	1,500	2,179.79
Same, upper Mississippi River and tributaries. 13th lighthouse district. Corrected to July 15, 1914. narrow 16mo	271	1,100	572.36
Same, Ohio, Tennessee, Kanawha, and Monongahela Rivers. 14th lighthouse district. Corrected to Sept. 15, 1914. narrow 16mo	141	1,000	382.62
Same, lower Mississippi River and tributaries. 15th lighthouse district. Corrected to Oct. 20, 1914. narrow 16mo	103	750	162.45
Atlantic coast of United States, buoy list, Delaware Bay and River, including Philadelphia Harbor. 4th lighthouse district. Corrected to June 1, 1915. 8vo	32	5,000	307.86
Same, Cape Henlopen to Cape Lookout, including Chesapeake Bay and North Carolina Sounds. 5th lighthouse district. Corrected to May 15, 1915. 8vo	125	5,500	1,315.26
Great Lakes, buoy list, Lake Erie, Lake Ontario, and St. Lawrence River. 10th lighthouse district. Corrected to Apr. 1, 1915. 8vo	31	1,500	271.55
Same, Lake Huron, Lake Superior, and connecting waters. 11th lighthouse district. Corrected to Apr. 1, 1915. 8vo	61	1,500	580.83
Same, Lake Michigan and Green Bay. 12th lighthouse district. Corrected to Apr. 1, 1915. 8vo	37	2,500	379.92
Gulf coast, buoy list, Cedar Keys to Rio Grande. 8th lighthouse district. Corrected to Aug. 15, 1914. 8vo	50	3,500	509.80
Specifications for single-screw, steel, steam-propelled lighthouse tender Cedar. 8vo	125	300	412.55
Specifications for twin-screw, steel, steam-propelled lighthouse tender Rose. 8vo	86	200	394.01
Specifications for two second-class single-screw steel light vessels no. 101 and no. 102. 8vo	73	200	308.97
Plans and specifications for buoys and appendages. July 1, 1915. 20 pl. 4to.	7	400	230.75
Proposal for supplies, [fiscal year] 1916. 3d lighthouse district. 4to	72	1,225	524.87
Proposal for coal, [fiscal year] 1916. 3d lighthouse district. 4to	24	175	96.96
Regulations for lighting bridges, 1914. 5 pl. 4to	14	1,000	149.51
Regulations for United States Lighthouse Service, 1914. 8vo	182	650	787.13

BUREAU OF NAVIGATION.

Annual report of Commissioner, 1914. [Printed also as H. doc. 1396, 63d Cong. 3d sess.] 8vo	206	1,000	$1,750.07
45th annual list of merchant vessels of United States, with official numbers and signal letters, and lists of vessels belonging to Government, with distinguishing signals, year ended June 30, 1913. [pts. 1–5.] [Reprint.] 4to	482	500	437.44

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BUREAU OF STANDARDS—Continued.

Title and description.	Pages.	Edition.
Scientific papers—Continued.		
233. Watthour meter method of testing instrument transformers; by P. G. Agnew. July 18, 1914. 4 text fig.	13	500
Same [reprint]	13	500
234. Insulating properties of solid dielectrics [with index to tables and curves]; by Harvey L. Curtis. June 8, 1914. 29 text fig.	66	1,000
Same [reprint]	66	500
235. Direct-reading instrument for measuring the logarithmic decrement and wave length of electromagnetic waves; by Frederick A. Kolster. Aug. 15, 1914. 3 pl. 2 pasters, 18 text fig.	37	500
236. Electrical resistance and critical ranges of pure iron; by G. K. Burgess and I. N. Kellberg. Aug. 21, 1914. 3 text fig.	16	500
Same [reprint]	16	750
237. Absorption, reflection, and dispersion constants of quarts; by W. W. Coblentz. Dec. 9, 1913. 2 text fig.	13	500
238. Characteristic equations of tungsten filament lamps and their application in heterochromatic photometry [with tables of characteristic relations]; by G. W. Middlekauff and J. F. Skogland. Oct. 10, 1914. 3 text fig.	54	1,000
239. Vibration electrometer; by Harvey L. Curtis. Sept. 29, 1914. 8 text fig.	20	500
240. Studies on the silver voltameter; by G. A. Hulett and G. W. Vinal. July 1, 1914. 3 text fig.	20	500
241. Wheatstone bridge for resistance thermometry; by C. W. Waidner, H. C. Dickinson, E. F. Mueller, and D. R. Harper 3d. Oct. 1, 1914. 2 pl. 6 p. of pl. 4 text fig.	22	500
242. Emissivity of metals and oxides: II. Measurements with the micropyrometer; by G. K. Burgess and R. G. Waltenberg. Oct. 24, 1914.	17	500
Same [reprint]	17	500
243. Emissivity of metals and oxides: III. Total emissivity of platinum and the relation between total emissivity and resistivity; by Paul D. Foote. Jan. 30, 1915. 1 text fig.	8	500
244. Comparison of stellar radiometers and radiometric measurements on 110 stars; by W. W. Coblentz. Nov. 5, 1914. 2 p. of pl. 2 text fig.	46	500
245. Temperature coefficient of magnetic permeability within the working range; by Raymond L. Sanford. Jan. 30, 1915. 5 text fig.	12	1,000
246. Methods of measuring the inductance of low-resistance standards; by Frank Wenner, Ernest Weibel, and F. B. Silsbee. May 28, 1915. 4 fig.	13	1,000
249. Emissivity of metals and oxides: IV. Iron ore; by George K. Burgess and Paul D. Foote. June 24, 1915. 2 text fig.	9	1,000
Bureau circulars [all large 8vo]:		
2. Measurements of length and area, including thermal expansion. 5th edition. Apr. 30, 1915. (Supersedes 3d edition of circular 2, Metal tapes.)	21	500
6. Fees for electric, magnetic, and photometric testing. 6th edition. Oct. 1, 1914.	27	2,000
9. Testing of glass volumetric apparatus. 7th edition. Oct. 1, 1914. 10 text fig.	31	500
10. Legal weights (in pounds) per bushel of various commodities. 2d edition. May 15, 1911. [Reprint.]	10	300
18. Standard gage for sheet and plate iron and steel. 2d edition. July 1, 1911. [Reprint.]	4	500
20. Electrical measuring instruments. 2d edition. May 28, 1915.	58	2,000
23. Standardization of electrical practice in mines. 1st edition. July 15, 1910. [Reprint with changes.]	93	500
30. Lime: Its properties and uses. 1st edition. Apr. 15, 1911. [Reprint.]	22	300
31. Copper wire tables. 3d edition. Oct. 1, 1914. 6 text fig.	76	3,000
32. Standards for gas service. 3d edition. Mar. 10, 1915. (Supersedes 2d edition of circular 32, Standard regulations for manufactured gas and gas service, and 1st edition, State and municipal regulations for the quality, distribution, and testing of illuminating gas.	197	2,000
33. United States Government specification for Portland cement. 2d edition. July 1, 1913. 10 text fig. [Reprint.]	28	1,000
34. Relation of the horsepower to the kilowatt. 2d edition. Aug. 1, 1914.	16	1,000
Same, 3d edition. May 15, 1915	16	1,000
35. Melting points of chemical elements, and other standard temperatures. 2d edition. Jan. 1, 1915.	2	1,000
37. Electric wire and cable terminology. 2d edition. Jan. 1, 1915. 15 text fig.	13	1,000
Same [reprint]	13	1,000
38. Testing of mechanical rubber goods. 2d edition. Apr. 5, 1913. 20 text fig. [Reprint.]	39	500
42. Metallographic testing. 1st edition. Sept. 1, 1915.	16	1,000

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3 messenger boys, at $480 each (increase of 1 submitted)	1,440
[NOTE.—There are now employed in the Division 3 messenger boys at $480 each, one of whom is on detail from the Bureau of the Census.]	
Total (31 employees)	35,020

The Division last year called attention to the fact that its work continues to increase without due regard to the personnel available for it. Within the past two years the duplicating section particularly has very greatly developed, at large cost to the other branches of the Division. A considerable part of the services of two employees of the editorial section are now devoted to preparing copy, reading proof, and revising incident to this work. In addition, one clerk in the mailing section is required to give practically all of his time to supervisory work and keeping of records in connection with the duplicating machines, and considerable time of a messenger is utilized in delivering completed work and proofs to the bureaus. The work of the bookkeeping and accounts section has also been greatly added to since the keeping of records of expenditures for printing and binding for the Bureau of the Census has devolved on the Division, and since the adoption of the practice of compiling and furnishing each month to the various bureaus, offices, and services statistics for use in making up their cost-keeping reports.

Practically all of this growth has taken place within two years and has been at a possible sacrifice of efficiency in some branches of the work. As an example, the editorial force, which has never been more than a skeleton of an efficient force, has necessarily had to contribute to the congested sections at great cost to its own work.

These conditions are unsatisfactory and can properly be remedied only by several additions to the personnel. The Division appreciates, however, the necessity for curtailing as much as possible at this time estimates which may involve additional appropriations by Congress, and has consequently decided to ask for but one additional employee and the transfer to the Division of the seven employees now on detail from the Bureau of the Census. Should these positions be given the Division, it will be possible, by special effort all along the line, to meet expected contingencies for the fiscal year 1917.

The Division desires to make as strong as possible its plea for an assistant chief, not only to provide a more evenly balanced personnel, but also to provide one more employee for a section of the Division which now is badly handicapped because of the amount of very important work devolving on a small and overworked force. The justification for a Division of Publications depends largely on the economies which it may effect in the publication work of the Department, and this in turn is dependent on acquiring and retaining an efficient corps of editorial clerks. This will not be possible, however, until the Department pays its employees salaries somewhat approaching those paid by other departments and by private employers. An assistant chief at a reasonable salary will be a far step in this direction.

The salary at present received by the clerk performing the functions of assistant chief is entirely out of keeping with the trustworthy character of the work and the dignity and responsibility of the position. Other officials performing duties which require similar educational qualifications, technical experience, and special prerequisites are, without exception, better rewarded. This is a matter of record and may easily be verified. In addition, the present case is especially

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